SCIENTIFIC AMERICAN

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Vol. XCVI.—No. 26.
ESTABLISHED 1845.

NEW YORK, JUNE 29, 1907.

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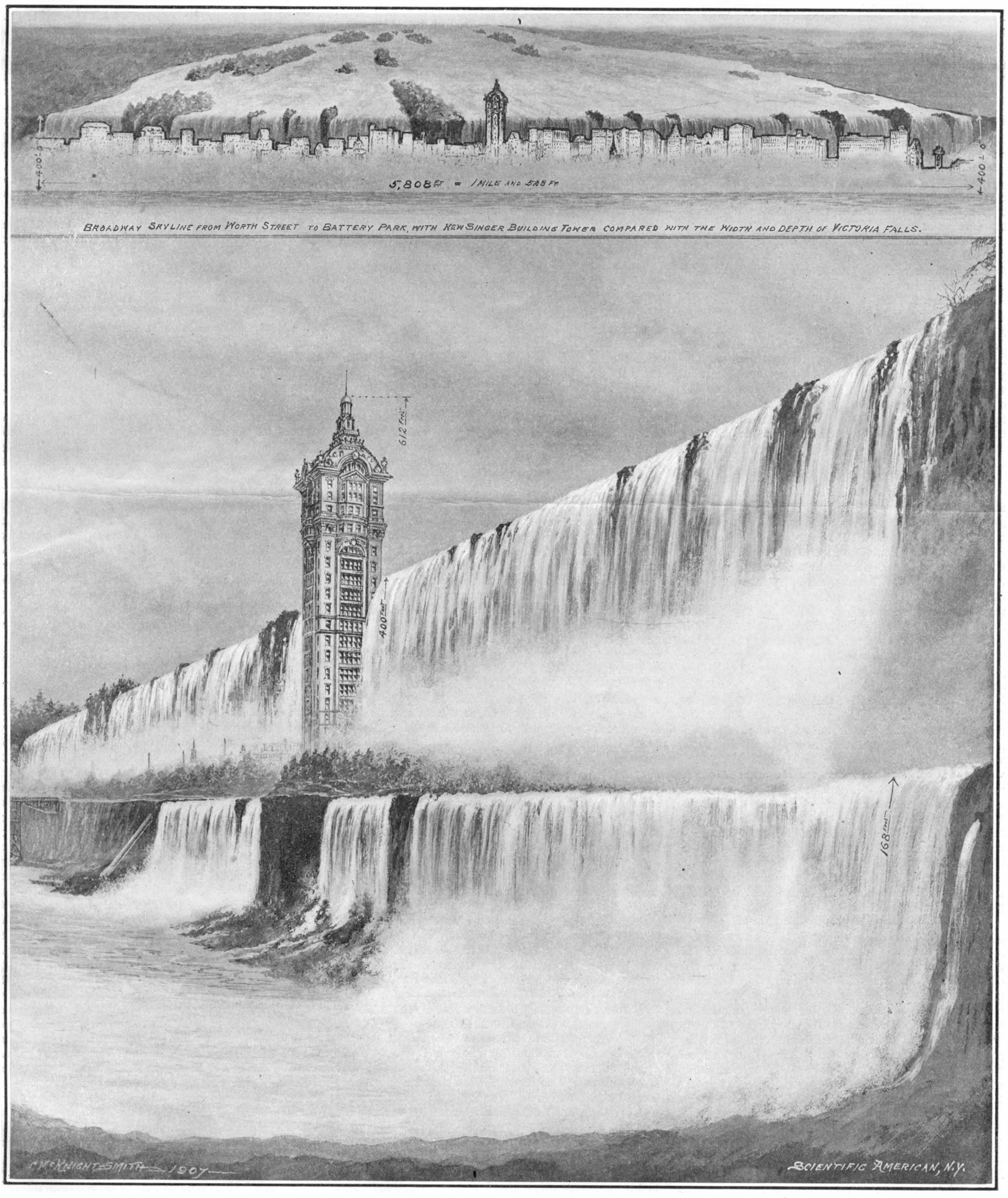
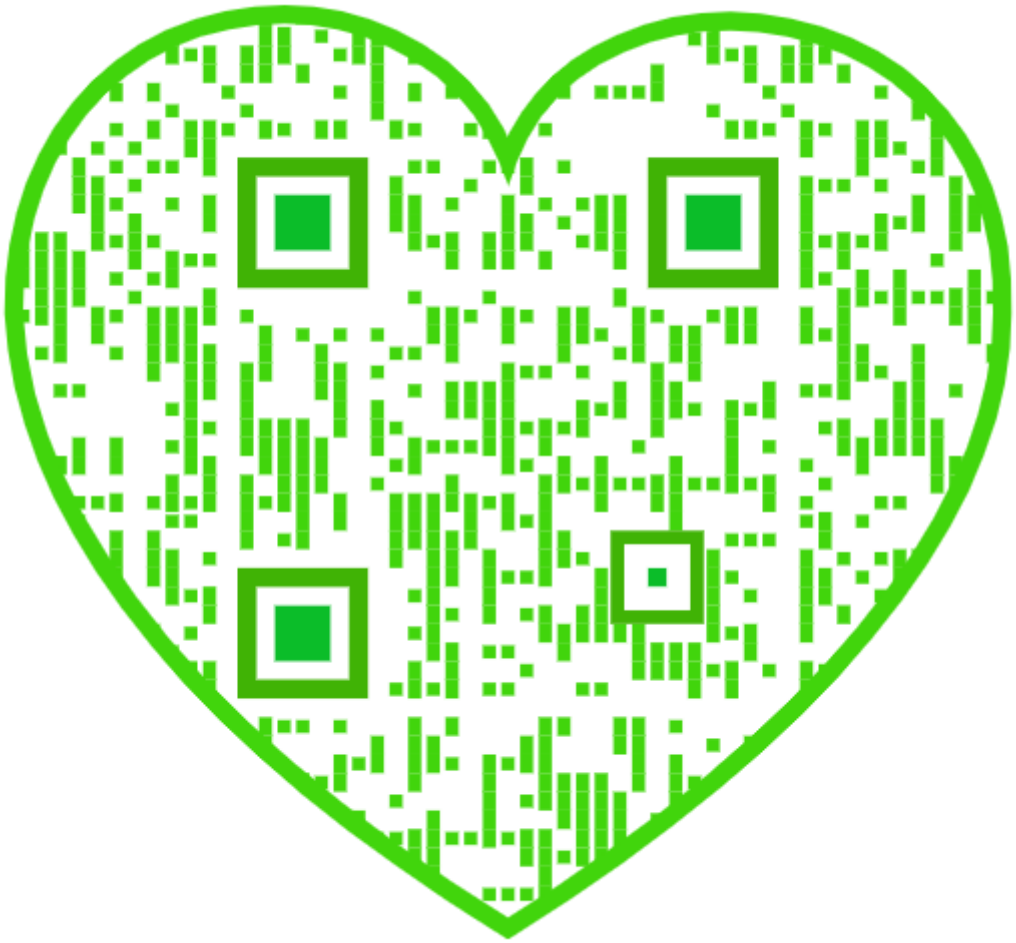

400 ft
5,808 Ft = 1 MILE AND 528 Ft
400 ft
BROADWAY SKYLINE FROM WORTH STREET TO BATTERY PARK, WITH NEW SINGER BUILDING TOWER COMPARED WITH THE WIDTH AND DEPTH OF VICTORIA FALLS.
612 Feet
400 Feet
168 Feet
C. McKNIGHT-SMITH 1907
SCIENTIFIC AMERICAN, N.Y.

Comparison of Victoria Falls (400 Feet High) With Niagara Falls (168 Feet High) and With the Sky Line of New York. Only the Singer Building's Tower Rises Above the Crest.

VICTORIA FALLS AS COMPARED WITH NIAGARA.—[See page 530.]



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MUNN & CO. - - Editors and Proprietors

Published Weekly at

No. 361 Broadway, New York

TERMS TO SUBSCRIBERS

One copy, one year, for the United States or Mexico.....$3.00
One copy, one year, for Canada.. ..... 3.75
One copy, one year, to any foreign country, postage prepaid, £0 18s. 6d. 4.50

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Scientific American (Established 1845) .....$3.00 a year
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MUNN & CO., 361 Broadway, New York.

NEW YORK, SATURDAY, JUNE 29, 1907.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

COSTLY IMPROVEMENTS IN NEW YORK CITY.

We have heard much talk of late about the magnitude of the Panama canal undertaking in respect of the number of men employed, the time it will take to construct, and its total cost to the country. Certainly, $180,000,000, more or less, is a huge sum of money to be spent on a single work, even by a nation as wealthy as our own. Nevertheless, it is a fact that, at the present time, there are being carried out in New York new engineering works of magnitude, public and private, whose total cost has been estimated at not less than $600,000,000; and much of this work has been planned, begun, and carried well on to completion, with not one-tenth of the discussion and worldwide advertisement, which has marked the operations on the Panama canal. Without entering into full particulars, it is sufficient to instance a few of the leading engineering works and their probable cost. In addition to the Catskill water supply, referred to on another page, which is to cost $162,000,000, two leading railroads of the country are rebuilding their terminal stations, and electrifying their terminal and suburban service, at a total cost for the two, which, judging from the way things are going, will not fall far short of $200,000,000. We refer to the electrification of the New York Central system and the construction of its new yard and station and offices, and to the carrying out by the Pennsylvania Railroad Company of similar works, which involve the construction of no less than six separate tunnels under the Hudson and East rivers and below Manhattan Island. Then there is the extensive work being done by the Hudson Companies, which are completing four tunnels below the Hudson River, and building an extensive system of subways below Jersey City and beneath the streets of Manhattan. The total cost of this work, by the time the terminal stations, yards, etc., are completed, will not be far short of $50,000,000. The Rapid Transit Commission, moreover, have laid out extensions of the Rapid Transit Subway, of which the first installment, which will soon be begun, will call for an expenditure of not less than $100,000,000. Add to this the two bridges which the city is building across the East River, costing together about $40,000,000; the connecting railway illustrated in our June 8 issue with its 1,000-foot four-track steel-arch bridge over the East River, to cost from $12,000,000 to $15,000,000, to say nothing of a large number of minor but costly improvements, and it can be seen that the total easily amounts to the $600,000,000 mentioned above.

AMERICAN YACHTING SEASON OF 1907.

The claim of the yachtsman that in spite of the great public interest aroused in yachting by the occurrence of the "America's" cup contests, such races are prejudicial to the interests of yachting in general, seems to be borne out by the experience of the past few seasons, in which the "America's" cup has been allowed to remain undisturbed in its resting place in the Tiffany vaults. These international races, moreover, have not only had the bad effect of monopolizing interest, but they have been the chief instruments in promoting the development of an exaggerated and unwholesome type of yacht, which is enormously costly to build and is useful for absolutely no other purpose than that of being towed out to the Sandy Hook lightship to sail a series of races in which the last conditions which the owners of either boat desire to meet are those of a reefing breeze and a heavy sea. When each race was over, the boats were worth merely as much as they would fetch when broken up for old junk.

American yachting was never in such a healthy condition as it is at the present time. The rules have been changed with a view to preventing extravagances of construction and producing seaworthy racing craft which, although but slightly inferior in speed to the older type, are stanch and strong and capable of being utilized by their owners for cruising under whatever kind of weather may be encountered.

The improvement in yachting is to be attributed largely to the growing popularity of long-distance, deep-sea racing, a movement which was first started by some of the minor clubs and among the smaller classes of yachts. Notable among these races is that for the Bermuda cup, the first of which was held last year, and was so successful that in the second race completed two or three weeks ago, no less than a dozen competitors were entered, and made the 650-mile run successfully; while the great ocean race of two years ago promoted by the Emperor of Germany will long be remembered for the number and size of the yachts that were entered, and the remarkably fast time made by the winners.

In addition to the promotion of deep-sea races, there has been a marked revival of interest in short-distance races held over the local courses. Among the large yachts there will be a series of closely-contested struggles between that fine schooner "Ingomar," which a few years ago swept everything before her in Europe, and the two crack schooners of last year, the "Elmina" and the "Queen."

In the 65-foot class the sloop "Effort," winner of the King's cup last year, a bronze boat, will be seen in contests with that veteran and always successful sloop the "Neola," the latter having been built under the old rule, and subsequently modified to meet the conditions of the new rule. In the 57-foot class three boats, which have already shown such great speed that they have beaten the larger "Effort" and "Neola" on time allowance, have been built by Herreshoff for three enthusiastic owners, who will race them for all they are worth during the coming season.

International racing, moreover, although there will be no "America's" cup contest, will be promoted by three events, each of extreme interest. The most important of these will be the race for what are known as the Sonderclasse boats. Out of about a score of American-built yachts, three will be selected to represent this country at Kiel, where they will defend the cup won by "Vim" last year in a series of races against three German competitors, and after these races the trio will compete in a series of contests to be held in Spanish waters. Then on Lake Ontario there will be an international race for the Canada cup; while another international contest will be the dory race, to be held between boats representing the Massachusetts Dory Racing Association and the Shelburne Yacht Club of Nova Scotia.

As for the prospect of any future races for the "America's" cup, the conditions are very problematical. There will, of course, be no race this year, and thus far no challenge has been received for a race in 1908. Last year Sir Thomas Lipton made some tentative overtures to the New York Yacht Club, by endeavoring to secure from that body a statement as to whether, if he should challenge with a boat built under the new rule of the New York Yacht Club, he would be met by a yacht designed under the same rule; but for reasons known only to themselves, the committee declined to make any promises, stating that after a definite challenge had been received they would be prepared to determine what type of boat would be forthcoming. The dilemma under which the challenger would be placed under existing conditions is, that if he built under the new rule, he might be confronted by such a boat as "Reliance," or an improved "Reliance," built under the old rule, a type against which a new-rule boat would have very little chance of success in the light drifting matches which have generally prevailed in international races held over the Sandy Hook course. It is the consensus of opinion among American yachtsmen in general, that the interests of the sport would be promoted, and the building of a more healthy type of boat insured, if the New York Yacht Club would consent to a series of races by boats built under their own present rule.

FORTY-FOUR-MILE ELECTRIFICATION ON THE WEST SHORE RAILROAD.

The electrification of the 44-mile stretch of the tracks of the West Shore Railroad which has just been completed has been carried through so quietly, that little has been heard of it outside of the particular stretch of country served and the railroad and electrical companies that have been making the important change.

The new equipment extends from Utica to Syracuse, and it has been undertaken with a view to meeting certain special transportation conditions in the district to be served. Until about two years ago, the various electric lines between Albany and Buffalo were owned independently of the New York Central Railroad, in whose hands were the only steam lines offering direct service; and this company being also the owners of the West Shore Railroad, have at their disposal six separate steam railroad tracks across the State. The New York Central took care of the passenger traffic and the fast freight, while the West Shore Railroad was devoted almost exclusively to freight service, only two or three through trains being run daily between New York and Buffalo. About ten years ago, with the completion of the interurban electric railroad from Buffalo to Niagara Falls, the steam railroad began to be confronted with an active competitor for the passenger service. The success of that line led to the construction of others, and gradually the scheme for a continuous interurban electric line from Buffalo to Albany began to appear feasible. At this time the New York Central began to gather in the various electrical lines that were in close competition with its steam lines, and having acquired these properties began to make a study of the problem of distributing the service to the best advantage between the electric and steam systems. On the stretch of country lying between Utica and Syracuse, the West Shore and the New York Central lines draw farther apart than at any other point in their route across the State, the distance by the West Shore line being about seven miles shorter than by the New York Central. The electrification of the West Shore line resulted from an agreement between the Oneida Railway Company and the New York Central Railroad Company, under which the former leased the tracks of the West Shore Railroad between Utica and Syracuse, equipped them for electrical operation, and is to conduct the passenger business. The New York Central, on the other hand, abandoned the West Shore local trains, but reserves the right to run its through steam trains and haul its steam freight trains as before.

The recent improvements have consisted of the addition to the two steam tracks already existing of fourteen additional miles of third and fourth tracks, and the relaying of the road throughout with 80-pound rail. Over this road there will be three classes of service, namely, fast electric trains, for single cars, making two stops only; local trains; and the steam service.

As between the single-phase high-voltage system with catenary overhead construction and the low-pressure direct-current system with third-rail distribution, it was decided that the latter would be more suitable to the conditions. In making the comparison, it was found that the cost of the overhead system and motor equipment for the single-phase system would be about as great as that of the direct system with sub-stations. With the overhead catenary construction, 1,250,000 pounds of copper would have been necessary for the feeders and trolley wire; but with the third-rail system the distribution would be through steel rails, which might more readily be used elsewhere in case a future change should be made. The fast electric cars or trains will make the run between Syracuse and Utica in one hour and twenty-eight minutes, and of this total time, twenty-eight minutes will be consumed on the local service in the suburbs of each city, the run between the cities themselves being made in one hour. The local trains will run at a speed of twenty-four miles an hour, and complete the 44-mile run in one hour and fifty-eight minutes.

An enterprise of considerable importance is now being carried out under the direction of the Swedish government. This consists in the use of the Tröllhattan Falls in order to operate a turbine plant. Current is to be generated in the station, and a power distribution line will be run for a distance of 45 miles to the city of Gothenburg. The work is undertaken in such a way as not to detract from the appearance of the falls or the surrounding country, nor on the other hand to cause any bad effect to the operation of the canal which connects Lake Wener with the Göta Elff and the Kattegat. As to the quantity of water which can be obtained by the present hydraulic construction, it is calculated to be 320 cubic meters (11,200 cubic feet) at low-water periods. Upon this total, 62 cubic meters (2,170 cubic feet) are to be reserved for the supply of the canal and 8 cubic meters (283 cubic feet) for a small hydraulic plant which is already erected at this point. A head of water of 70 meters (231 feet) is counted upon, and the total amount of power which can be obtained by the present plant is 75,000 horse-power. According to the present designs, the turbine house is to contain a certain number of 10,000-horse-power turbine and dynamo groups, using the Francis type of turbines. As a result of the current supply which will be secured in this case, it is probable that ore from the north of Sweden will be transported to Gothenburg and will be treated by an electric process in large works which are to be erected for the purpose. An electric railroad will be built specially for the hauling of the ore.

Consul Frank Hannah of Magdeburg sends information of a new German composition to take the place of cedar in lead pencils. The principal ingredient of the substitute is potatoes. The pencils are now being manufactured and soon will be on the market. It is estimated that to manufacture these pencils will take about half of the time required to make cedar pencils.

THE HEAVENS IN JULY.

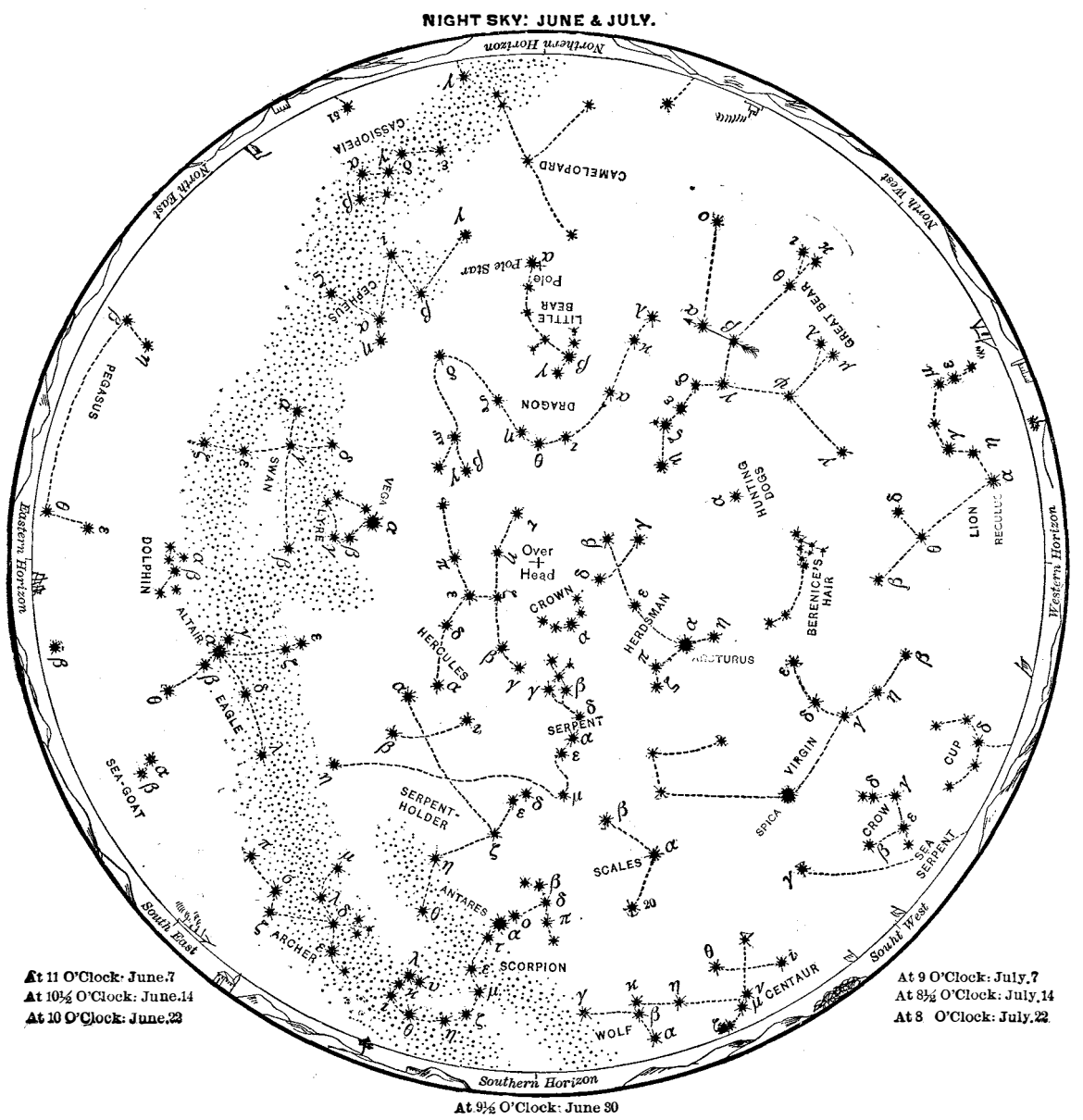
BY HENRY NORRIS RUSSELL, PH.D.

Two eclipses, and the opposition of Mars, make the month of July this year a notable one from the astronomer's standpoint. The first of these eclipses, which occurs on the 10th, will not be visible in this country, and can only be observed from South America. Observers in the northern or southern part of this continent will see only a small part of the sun's disk obscured by the moon, but along a wide track, which passes somewhat north of Rio de Janeiro, the moon will be seen projected upon the sun's face, giving rise to an annular eclipse.

A fortnight later, on the evening of the 24th, there is a partial eclipse of the moon, visible throughout the United States. The moon enters the penumbra at 8:59 P. M. Eastern Standard time, but first touches the dark shadow of the earth at 10:04. When the eclipse is at its largest, at 11:22 P. M., about five-eighths of the moon's diameter is hidden. Then the obscuration decreases and at 12:41 the moon leaves the shadow and gets clear of the penumbra at 1:46 A.M.

This eclipse will be very conveniently visible in this country. It is one of the few astronomical phenomena which can be seen almost as well with the naked eye as with the telescope. The edge of the earth's shadow, which looks sharp enough to the unaided vision, is really very diffuse on account of the refraction of sunlight into the shadow by the outer layers of our atmosphere. It is impossible to fix its exact position on the moon or to determine with any accuracy the time at which it reaches any definite point. This deprives a lunar eclipse of most of the scientific value that it would otherwise have, for we cannot find from it, as we can from a solar eclipse, the exact time when the moon was in a known position, and so cannot use it to correct our tables of the moon's motion.

Of much greater importance to astronomers is the very favorable opposition of Mars, which occurs on the 6th. Although Mars comes to opposition every other year (roughly speaking), he can be much better seen at some of these times than at others. At every opposition the earth is (approximately) in line between the sun and Mars, so that the planet's distance from us is equal to the difference of the distances of the earth and Mars from the sun. The earth's orbit is nearly circular, but that of Mars is considerably eccentric, so that his distance from the sun varies from about 129 to 155 million miles, while the earth's distance varies from 92 to 94 million.



In the map, stars of the first magnitnde are eight-pointed, second magnitude, six-pointed; third magnitude, five-pointed; fourth magnitude (a few), four-pointed; fifth magnitude (very few), three-pointed, counting the points only as shown in the solid outline, without the intermediate lines signifying star rays.

At present Mars is almost at his nearest to the sun—132 million miles distant—and the earth is about at its farthest, so that the distance between the two is reduced to 38 million miles, as against 49 million at the average opposition, and 62 million at the least favorable.

Being so near us, Mars looks correspondingly large in the telescope, and bright to the naked eye. He is, however, very low down in our skies, his declination being 28 deg. south, so that he is at most 22 deg. above our horizon and only 10 deg. high at Greenwich. He can hardly be observed at all in northern Europe, and only with difficulty in this country, so far as the finer details go. But the southern observers will doubtless be busy, and Mr. Lowell, who has always made Mars a special study, has sent an expedition to South America for the express purpose.

Meanwhile the news comes from his observatory in Arizona that some of the "canals" on the planet's disk have again been photographed there, and we may hope that this summer's work will give us important and perhaps conclusive evidence of the nature of these singular markings.

THE HEAVENS.

Turning to our map, we may begin by identifying the very bright star Arcturus, which is due southwest very high up, and to which the curve of the dipper-handle points. Below this, in the southwest, the less brilliant but whiter star is Spica, in the constellation of the Virgin. Another equally white star, a shade fainter than the last, is Regulus, in the Lion, which is just setting.

The Dragon and the Little Bear are above the Pole, and the Great Bear lies to the westward, while Cassiopeia and Cepheus are toward the east.

In the east are Cygnus, the Swan, and above it Lyra, with the great blue star Vega. Farther south is Altair, in the constellation of the Eagle, and lower down, on the left and right, the Dolphin and the Sea-Goat (Capricornus). Hercules and the Northern Crown lie between Vega and Arcturus, and south of them the Serpent-Holder (Ophiuchus) and the Serpent fill a great area of sky.

West of south is a part of the Centaur, whose brightest stars we never see, and farther east is the Scorpion, with the red star Antares. Mars, which is in Sagittarius, is well up in the southeast, and is much brighter than anything else in sight.

THE PLANETS.

Mercury is evening star until the 24th, when he passes through inferior conjunction, and becomes a morning star. He can be seen in the twilight during the first few days of the month, when he sets at about 8:30 P. M. Venus is morning star in Taurus and Gemini and rises at about 3:30 A. M. in the middle of the month.

Mars is in Sagittarius, coming to opposition on the 6th, and is visible all night long, as already described.

Jupiter is in conjunction with the sun on the 16th, and is invisible throughout the month.

Saturn is in Aquarius and rises about 10:30 P. M. in the middle of the month. Uranus is in Sagittarius, close to Mars, and comes to opposition on the 3d. The two are in conjunction on the 19th. At this time Uranus is 5 deg. 18 min. north of Mars, and it will not be difficult to pick him up, even with a field glass, and make sure of the identification by watching his slow westward motion among the stars.

Neptune is in conjunction with the sun on the 5th, and is invisible throughout the month.

THE MOON.

Last quarter occurs at 9 A. M. on the 2d, new moon at 10 A. M. on the 10th, first quarter at 8 A. M. on the 18th, full moon at 11 P. M. on the 24th, and last quarter once more at 9 P. M. on the 31st. The moon is nearest us on the 23d, and farthest away on the 9th. She is in conjunction with Venus on the 8th, Neptune and Jupiter on the 10th, Mercury on the 12th, Mars and Uranus on the 23d, and Saturn on the 28th.

COMETS C AND D, 1907.

A faint comet was discovered by Giacobini at Nice on June 1. It is in Leo, and is now receding from us and growing very faint. A much brighter comet was discovered on the morning of June 10 (civil reckoning) by Mr. Zaccheus Daniel, a student in Princeton University, and assistant at this observatory. It is in Pisces, very near the equinoctial point, and is moving slowly eastward, almost in the ecliptic. Elements of its orbit have not yet come to hand.

Princeton University Observatory.

CONVERTING MUSIC INTO ELECTRICITY.

A successful attempt, as is well known, has recently been made to produce music immediately from electricity by means of the telharmonium of Dr. Cahill, without the aid of any musical instrument. In this connection it will be interesting to learn that a French scientist, Dr. M. Dupont, a short time ago succeeded in converting music into electricity, by reproducing in the shape of an alternating current the series of vibrations corresponding with a series of musical sounds. This alternating current affords a picture of the sound vibrations that constitute a musical performance, and is able to produce physiological effects similar to the hearing of music. The alternating current in question is made up of periods, the frequency of which corresponds with the number of vibrations of the sound, that is, with the pitch, a high sound yielding a rapidly vibrating current and a low one a current with long periods. The ratios between the various phases of the current periods are identical with the ratios between the sound intervals. The alternating current corresponding with a scale thus comprises a series of periods, the number and ratios of which are equivalent to the frequency and ratios of the sounds of the scale.

In reproducing these musical currents, Dr. Dupont uses a phonograph to which a microphone is fitted. After recording a musical scale on the phonograph cylinder, the apparatus is made to work, when the microphone will yield an alternating current as above described. The microphone circuit comprises the primary of an induction coil without its interrupter. By means of this transformer the alternating currents obtained are controlled at will before being applied to the organism.

If in the place of a scale a piece of music be chosen, the alternating current, on passing through the human body, will produce the physiological effects of that piece.

After some practice it will doubtless be possible to tell a piece of music by the corresponding currents traversing the tissues of the body, in the same way as by hearing it. This process might prove especially valuable in the case of deaf mutes.

Dr. Dupont has undertaken extensive researches on the physiological effects produced by these rhythmical currents on the nervous system. It is hoped to ascertain the kind of current corresponding with each given condition of the mind, so as to be able at will to exert an exciting or calming action.

In this connection it should be remembered that Dr. Leduc some years ago investigated the calming and anesthetizing effects of rapidly intermittent direct currents of low intensity.

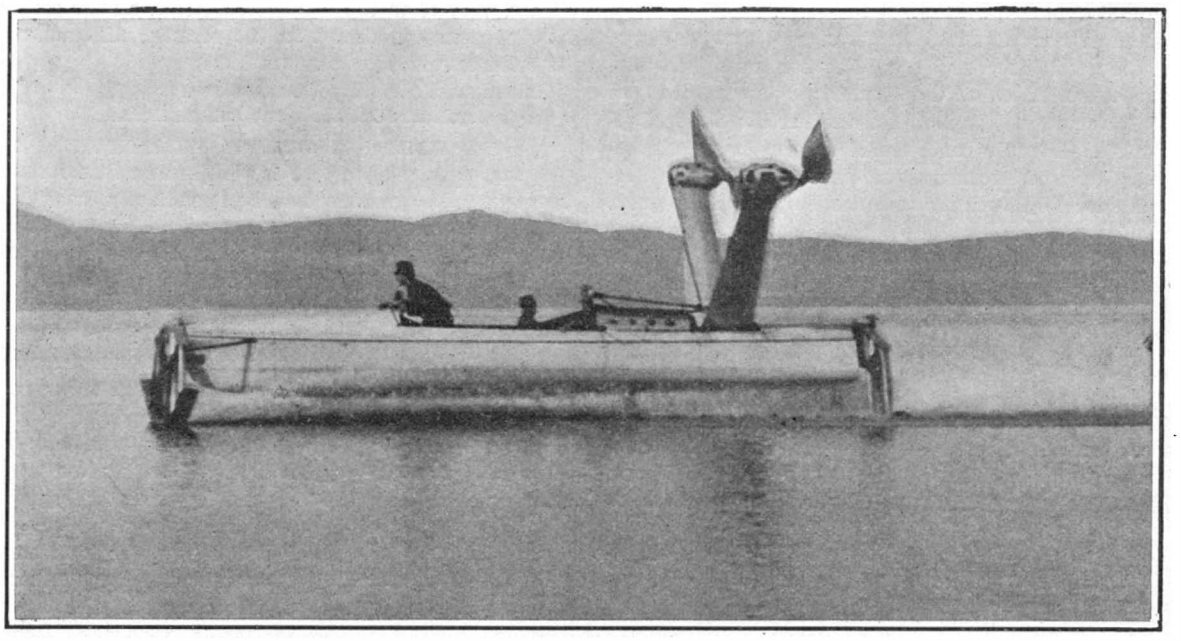
Death of Prof. Alexander Herschel.

Prof. Alexander Stewart Herschel, M. A., the distinguished astronomer, died on June 18, 1907, at the Observatory House, Slough, Bucks, where his grandfather, Sir William Herschel, and Sir John Herschel made most of their world-famous discoveries.

Prof. Herschel was a fellow of the Royal Society and was a doctor of civil law. He was professor of physics and experimental philosophy at the Durham College of Science at Newcastle-on-Tyne.

A NEW HYDROPLANE BOAT.

Our illustration shows a remarkable photograph of a new hydroplane boat, which was first experimented with successfully on Lake Bracciano, near Rome, Italy, on the 22d of last month. This boat was designed and built by Messrs. Crocco and Ricaldoni, of the Brigata Specialisti, Rome. It is fitted with two V-shaped fins at the bow and stern, respectively, in accordance with a patent issued to an Englishman named Thompson, and modified somewhat by the present experimenters. The boat is fitted with an 80 to 100 horse-power gasoline motor, which drives two air propellers that propelled the boat first through and then above the surface of the water, as can be seen from the photograph. The weight of the boat complete with two men on board is 1,500 kilogrammes (3,300 pounds), and it is to attain a speed of about 40 miles an hour, although the inventors do not state the speed actually attained thus far.



An 80 H. P. Hydroplane Boat Driven by Air Propellers.

THE MOST POWERFUL EXPRESS LOCOMOTIVE EVER BUILT.

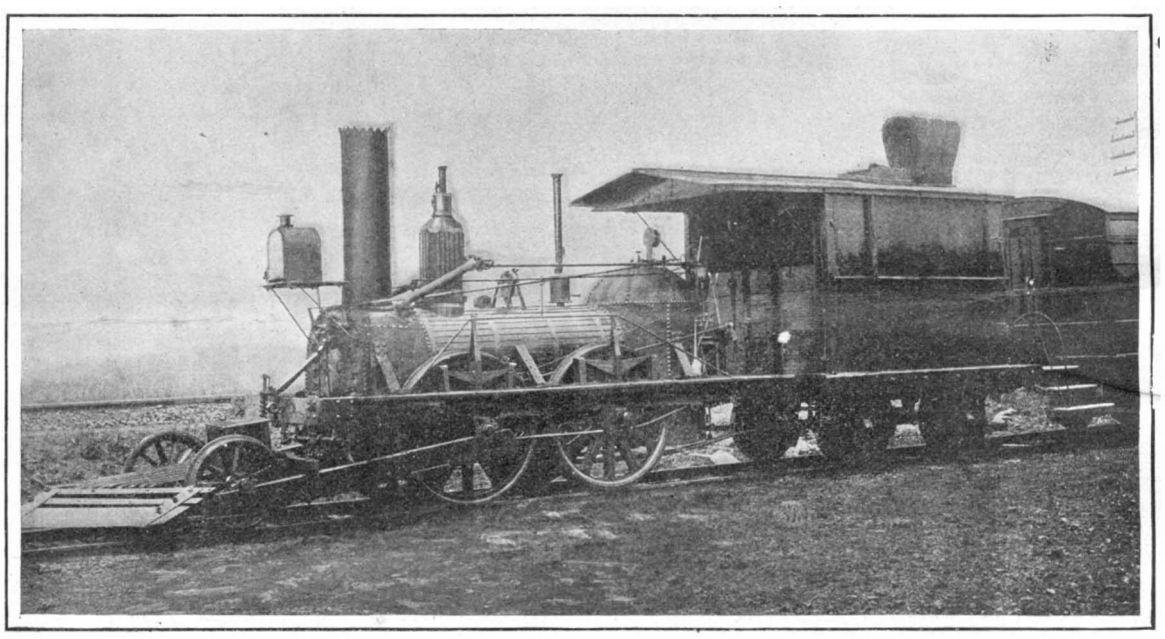
The truly enormous express locomotive shown in the accompanying illustration represents the latest effort of one of our leading railroads to keep pace with the ever-growing demands of its express passenger service. This company has just received the new locomotive from the shops, and placed it in trial service, in the hope that it will prove equal to the task of handling in one train passenger trains which otherwise must be run in two sections several minutes apart, or else handled by "double-heading," that is, coupling up two locomotives at the head of a train.

The most powerful Pennsylvania standard express engines at present in service are themselves heavy and powerful machines, with cylinders 22 inches diameter by 26 inches stroke, which, on divisions having heavy grades, are capable of successfully handling trains made up of eight Pullman cars. But the passenger traffic has increased so rapidly that ten or twelve car trains are not unusual. The capacity of the Atlantic type, with four-coupled drivers, could not be increased sufficiently to meet the demands without adding considerably to the weight on the drivers. To gain the required capacity, therefore, it was found necessary to add another pair of drivers, and adopt what is known as the Pacific type of locomotive, in which the total necessary adhesive weight was realized without exceeding a load of 60,000 pounds on any one pair of drivers.

The dimensions of the new locomotive greatly exceed anything hitherto built, or that would have been considered possible a few years ago. We all remember the great interest which engine No. 999, built especially for hauling the Empire State express of the New York Central Railroad, excited when she was exhibited at the Chicago World's Fair. Yet, to-day it would take two of such engines coupled together to do the work that can be performed by the new Pennsylvania engine; for the latter locomotive, with water in its boiler and in running condition, weighs 134.6 tons; its tender when loaded with 11 tons of coal and 7 tons of water, weighs 70 tons, making a total for the engine and tender of 204.6 American tons, or 409,200 pounds.

COMPARISON OF THE FIRST AND LATEST LOCOMOTIVE OF THE PENNSYLVANIA RAILROAD.

	John Bull.	Pacific Type.
Date	1831.	1907.
Weight	10 tons.	134.6 tons.
Boiler diameter	3 ft. 6 ins.	6 ft. 7¾ ins.
Total heating surface	249 sq. ft.	4,322 sq. ft.
Diameter of cylinders	9 ins.	24 ins.
Stroke of cylinders	20 ins.	26 ins.
Volume of cylinders	1,273 cu. ins.	11,378 cu. ins.



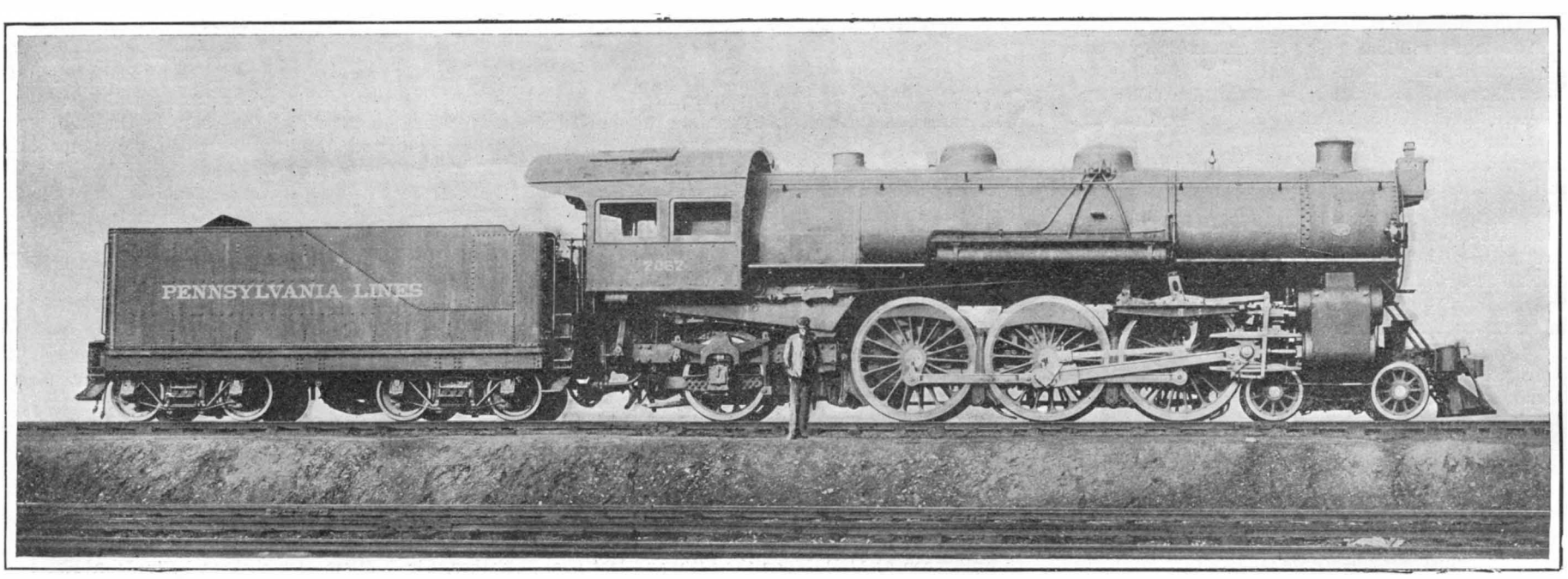
Cylinders, 9 inches diameter by 20 inches stroke. Total heating surface, 249 square feet. Weight, 10 tons.

The "John Bull"; Built in 1831.

In order that the great power of the locomotive might be available at fairly high speeds, the drivers were made 80 inches in diameter, which is the same as that of the Atlantic type. The cylinders are 24 inches in diameter by 26 inches stroke, and the piston valves, which are operated by the Walschaert gear, are themselves 16 inches in diameter. The valve gear, which has been carefully designed with a view to bringing its working parts into one plane, is provided with a special supporting frame outside of the link. This frame will be observed in the accompanying view of the engine.

It will readily be understood that to supply sufficient steam for cylinders of this great capacity, an unusually large boiler was necessary. To begin with, the tubes, which are 2¼ inches in diameter, are 6 feet longer than those of the Atlantic type, or 21 feet over all; and of these there are 343 whose combined heating surface is 4,117 square feet. As there are 205 square feet in the firebox, the total heating surface reaches the enormous area of 4,322 square feet. The coal is burned on a grate whose area is 61.8 square feet. The maximum diameter of the barrel of the boiler is 79¾ inches, so that a man six feet tall could walk through the boiler shell, and yet clear the top of it by over half a foot. The maximum tractive power is 31,000 pounds or 15½ tons.

(*Continued on page* 530.)



Cylinders, 24 inches diameter by 26 inches stroke. Total heating surface, 4,322 square feet. Weight, engine alone, 134.6 tons.

New Locomotive for Heavy Express Service.

THE FIRST AND LATEST LOCOMOTIVES OF THE PENNSYLVANIA RAILROAD.

SOUND SIGNALS FOR MARINERS: AN INVENTIVE FIELD WHICH IS NOT OVERWORKED.

BY C. H. CLAUDY.

Inventors often complain that the field of their activities is limited by the very fact of those activities; that all the little conveniences have been thought of by some one else, and that the big things take too much money to introduce! In a measure this is true, but there are exceptions. There are some inventions of comparatively large size and cost, which if made would find a ready market. The very best market in this country for some things, if they are good, is the United States government, and of some classes of inventions it is a liberal patron.

The subject of this paper is to present to inventors an outline sketch of the field of sound signals for marine use. At practically every lighthouse of importance on the coasts of this country is some sort of signaling apparatus, to be used when weather conditions prevent the lights from being seen. Sometimes it is a bell, sometimes a whistle, sometimes a Daboll trumpet, sometimes a steam siren. The idea is to make a noise which will be heard where ordinarily the light would be seen, to give the mariner warning which a fog prevents the light from giving. Of course, in the case of a first order light, which may be seen twenty miles, the signal is, in part, a failure, only the best and most favorable of conditions carrying a siren sound so far. The signals, of course, have certain characteristics, to prevent the hearer from mistaking one signal for another.

At certain times, in certain weathers, and more particularly in certain localities, these sound signals behave, as far as their hearers are concerned, in a most erratic manner. In some cases the Lighthouse Board gets indignant complaints that on a certain date a certain fog signal was silent when it should have sounded. Investigation shows that the signal was sounding at the time, but was, for some inexplicable reason, inaudible to the very ship it was meant to reach. Naturally, such instances have been very carefully investigated, and certain facts have come to light as a result. It has been found that sound, like light, is sometimes affected by atmospheric conditions, and that it will skip about in a most bewildering way. Thus, a fog signal may be heard with ear-splitting force a mile from its source, and five hundred yards farther on may disappear entirely. Yet another five hundred yards, and it again sounds, as strongly as before. The theory in such a case as this is that the sound hits the water and is echoed back from it into the air, to return in a curve of more or less magnitude and again strike the water. The sound, in other words, skips, like a stone skillfully thrown into the water, the points of audibility corresponding to the places the water is hit—the areas of silence to the flights of the stone.

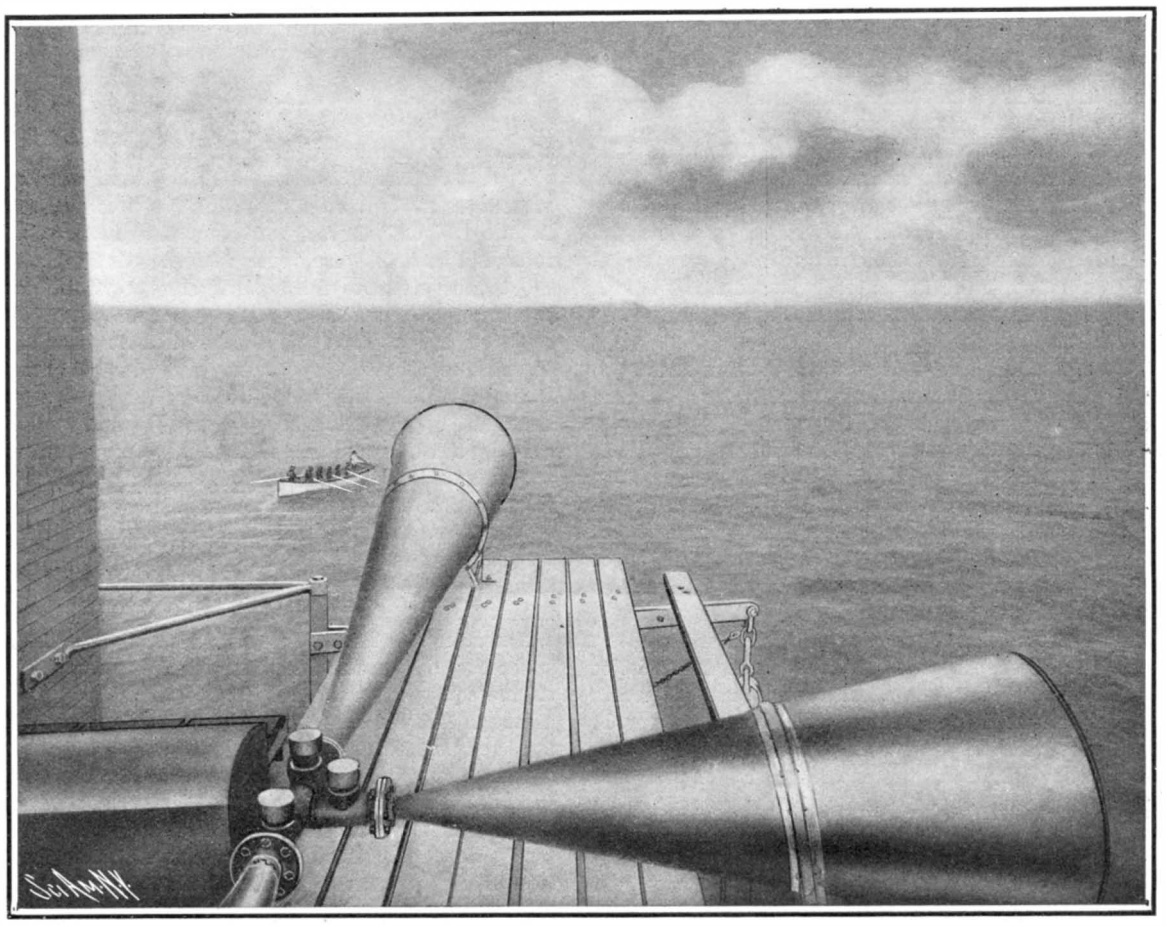
This is a simple case. In others, the sound forms a circle, a ring of audibility, outside of which there is silence, and inside of which nothing in the nature of a signal can be heard. And to make the matter more puzzling, the conditions sometimes do not appear, and the signal acts as it should, while at other and rarer occasions, it takes these freaks and fails in its purpose.

As yet no laws have been deduced to cover the cases in point. But the following list of cautions to mariners, published by the Lighthouse Board as suggestions merely, give an idea of the trend of investigation:

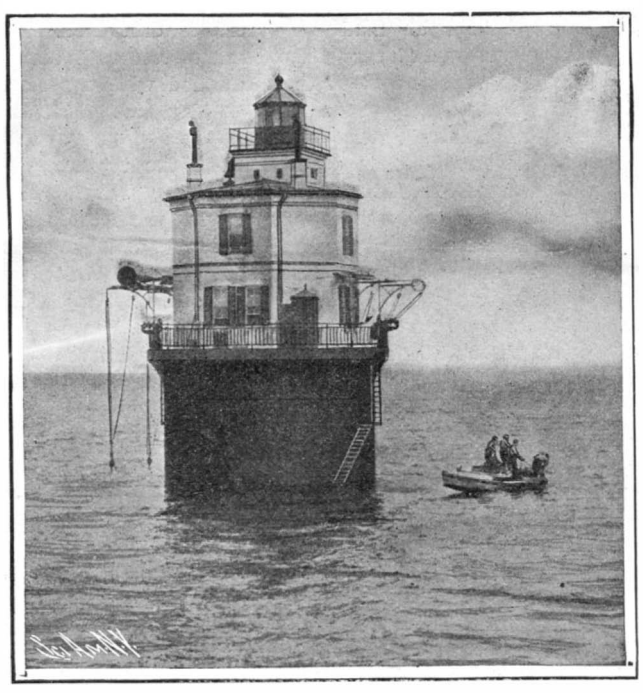
The mariner should, when approaching the sound from windward, go aloft, and when approaching from the leeward, the nearer he can get to the surface of the water, the sooner he will hear the sound. A mariner should not assume he is out of hearing of the fog signal because he fails to hear the sound. He should not assume that because he hears a fog signal faintly, he is at a great distance from it. Neither should he assume he is close to it because he hears the sound plainly. He should not assume he is at a given place in his course because he hears the sound with the same intensity he did on a former occasion. He should not assume that the signal has ceased sounding because he fails to hear it even within easy earshot. He should not assume that the aberrations of audibility of one fog signal pertain to any other fog signal. He should not expect to hear a fog signal as well when the upper and lower air currents run in different directions; that is, when his upper sails fill and the lower ones flap, or the lower ones fill and the upper ones flap. He should not expect to hear a fog signal well when between him and it is a swiftly-flowing stream, or when wind and tide are in opposite directions. He should not expect to hear it well during an electric disturbance. He should not expect the sound to reach him well over a bluff or over land. When there is a bluff behind the signal, he should be prepared for skipping, that is, he might hear it at two, four, six, eight, and ten miles from the trumpet, and lose it one, three, five, seven, and nine miles away, or any other combination, regular or irregular.

A further sentence in this publication is commended to the careful reading of inventors who doubt the extent of the field:

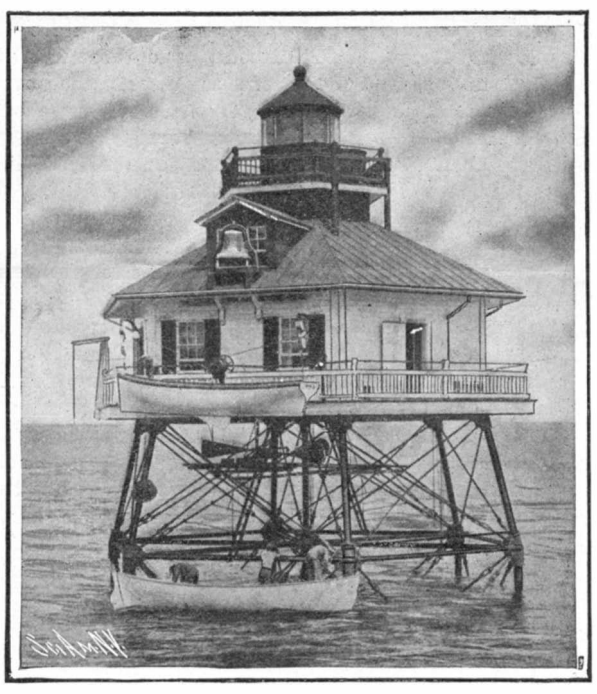
"If the law of these aberrations in audibility can be evolved, and some method discovered for their correction, as the variations of the compass are corrected, then sound may be depended upon as a more definite and accurate aid to navigation." Prof. Henry, one of the greatest scientists this country has



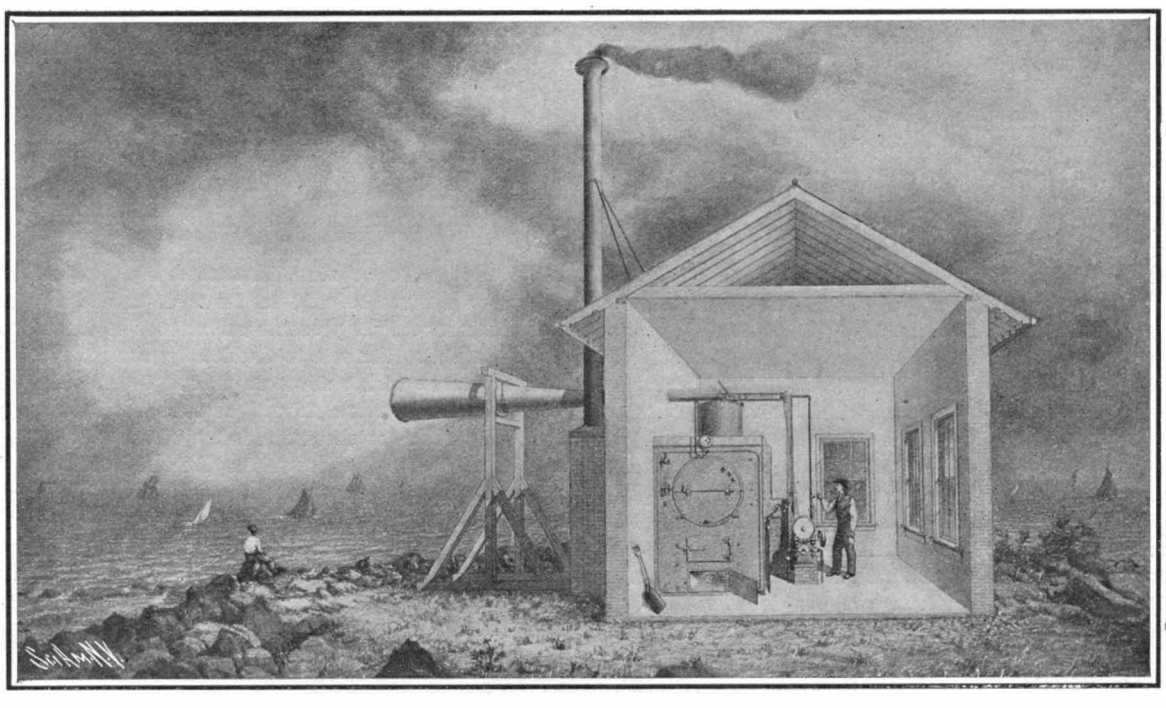
Daboll Trumpets in Which the Sound is Produced by a Vibrating Steel Reed.



Caisson Lighthouse, Chesapeake Bay, With Three Daboll Trumpets.



Thimble Shoals Lighthouse, Showing Trumpets Below Worked by Compressed Air.



Interior of Steam Siren Station. Penetrating Sound Caused by Revolving Disk in Throat Which Interrupts the Steam 30,000 Times per Minute.

SOUND SIGNALS FOR MARINERS.

ever had the honor to own, classified these abnormal sound aberrations as follows:

1. The audibility of a sound at a distance, and its inaudibility nearer the source of sound.

2. The inaudibility of a sound at a given distance in one direction, while a lesser sound is heard at the same distance in another direction.

3. The audibility at one time at a distance of several miles, while at another the sound can not be heard more than a fifth of the same distance.

4. While the sound is generally heard farther with the wind than against it, in some instances the reverse is the case.

5. The sudden loss of sound in passing from one locality to another in the same vicinity, the distance of the source of sound being the same.

Now, then, the problem can be stated as follows:

To invent or discover a sound-producing apparatus, no more complicated or expensive, or but slightly more so, than those in use, which will be heard uniformly at uniform distances, exception being made in favor of sounds swept away by a heavy wind; or to invent or discover a means of improving present fog signals, as a resonator or reflector, which will so amplify, direct, reflect, or otherwise project the sound that it will not be subject to the aberrations above described, saving that caused by a heavy wind. There is a wide market ready for the invention which solves this problem. In October, 1906, there were four hundred and fifty fog signals in the United States, operated by machinery, not including two hundred and thirty-four whistling and bell buoys. Then there are some thousands of vessels, all with fog signals, not belonging to the United States, and sixty lightships, the fog signals of which are supposed to be as reliable as can be made.

But the problem has another side. It is not enough to warn the mariner of a danger, or point out the course, by a sound; it is necessary to provide him with a means of finding the direction of the sound. Can you locate a cricket?

In a fog the sound seems to come from all directions, unless it is right on top of the vessel, and then the inevitable collision results. The very fact that in spite of warning apparatus of the greatest power collisions frequently occur, shows that some method is needed to definitely locate a sound.

Some vessels now carry a sound-receiving apparatus, consisting of a telephone and microphone immersed in wells in the ship connecting with the water outside, and designed to hear under-water vibrations. There is now an under-water bell on lightships, put overboard in a fog, designed to warn ships so equipped. It is hoped that in time apparatus will be designed by which the sound's direction can be recognized by turning the telephone receiver this way and that until the direction is ascertained by the loudness of the sound. A similar idea is in the invention of Prof. Mayer's "topophone," in which the sound wave is defined by means of resonators. But the apparatus requires the resonators to be attuned to the source of sound and an undistorted sound wave, and is not yet practicable.

The accompanying illustrations show some of the sound signal apparatus now in use. The Daboll trumpets are blown by compressed air, the power being furnished by an oil engine. One of the illustrations shows the interior of a typical first-order siren station. Although an ear-splitting sound may be produced from this steel throat, capable of carrying thirty miles under favorable conditions, the sound may be inaudible just when it is most needed, due to the causes suggested in the first part of this paper.

THE MOST POWERFUL EXPRESS LOCOMOTIVE EVER BUILT.

(*Continued from page* 528.)

By the courtesy of the Pennsylvania Railroad Company, we present, for comparison with their latest locomotive, a photograph of a diminutive engine, which has the distinction of having been the first to haul a train over the lines now owned by this company. The smaller engraving represents the celebrated "John Bull," which is now in the National Museum at Washington. It was the first engine used on the Camden & Amboy Railroad, which is now a part of the Pennsylvania system; and it was built in England in 1830 by Stephenson & Co., of Newcastle-on-Tyne, to the order of Robert L. Stevens, president of the railroad. It reached Bordentown, N. J., in August, 1831. The engine was originally named "Stevens," but on its arrival in this country the railroad company renamed it "John Bull." It was put in service November 12, 1831, at Bordentown, N. J., at the place where the Railroad Monument now stands.

The leading dimensions are as follows: Weight about 10 tons; boiler, 3 feet 6 inches diameter; cylinders, 9 inches diameter by 20 inches stroke. Four coupled wheels 4 feet 6 inches diameter, with cast-iron hubs and locust wood spokes and felloes. Tires of wrought iron ¾ inch thick; sixty-two tubes, 7 feet 6 inches long by 2 inches diameter. Furnace 3 feet 7 inches long by 3 feet 2 inches high (for burning wood). Heating surface of tubes, 213 square feet; of firebox, 36 square feet. Total heating surface, 249 square feet. The firebox was of the dome or Bury pattern. The reversing gear was complicated, the two eccentrics being secured to a sleeve or barrel, which fitted loosely on the crank shaft.

Soon after the engine arrived, the Camden & Amboy mechanics made the following changes and additions: As the railroad curves were very sharp, the coupling rods and cranks were removed and a lateral play of 1½ inches given to the leading axle, to which a cow-catcher was connected. The wooden wheels were replaced by cast-iron wheels. The dome was moved forward to the former manhole and the boiler lagged with wood. A bell was placed on the boiler and a headlight on the smokebox. A new tender was subsequently built, having a small cab on the rear for the accommodation of a brakeman, who, if anything went wrong with the cars, could signal the engine driver to stop. A cab and a large wood-burning chimney were subsequently added, but both these were removed some time before the engine was placed in the United States National Museum.

According to Mr. Herbert T. Walker, a well-known authority on locomotive history, this was the first engine equipped with a bell, headlight, and cowcatcher, although bells were used on English locomotives as far back as 1827.

This remarkable locomotive was exhibited at the Philadelphia Exposition of 1876, and again at the Chicago Exposition of Railway Appliances in 1883, and lastly, at the Columbian Exposition of 1893. Leaving New York city under steam April 17, 1893, it hauled "the John Bull train" of two cars 912 miles, without assistance, to Chicago, arriving April 22, and meeting with a continued ovation over the entire route. It formed part of the Pennsylvania Railroad's Company's exhibit, and was one of the great attractions of the World's Fair, carrying over fifty thousand passengers over the exhibition tracks in the terminal station yard. The engine left Chicago again under steam December 5, 1893, coming east over the Pennsylvania lines *via* the Southwest system to Pittsburg, and through Altoona, Harrisburg, and Baltimore to Washington, arriving there December 13, 1893. This was a very good performance for a locomotive sixty-two years of age. It was then returned to the museum at Washington, where it will remain permanently.

THE MAGNITUDE OF VICTORIA FALLS.

Oozing out of a black, boggy depression in the heart of Southern Africa is a sluggish, muddy stream which wends its way southward, very leisurely at first, but it soon grows rapidly in size and strength until it pours into the Indian Ocean, 1,650 miles away, fourth in rank among the mighty rivers of Africa. About 700 miles from its source, and just beyond the cataracts of Mololo, the Zambesi, joined by the waters of the Kwando River, spreads out into what might be termed a lake about six miles long and over a mile in width. This lake is studded with islands and the surface is very smooth, the vegetation along the banks being perfectly mirrored in the placid water. Strange to say, the lower end of this lake is marked not by a shore line nor by the slightest narrowing of its surface, but by an abrupt fall beside which our much-vaunted Niagara is a mere pygmy. It is an entire lake that takes the plunge, and not merely a river.

A comparison of Niagara and Victoria Falls is pictured in the front-page illustration, which shows at a glance how vastly greater is the African falls. At Niagara the river takes a plunge of 168 feet, but the Zambesi falls sheer 400 feet. The crest of Victoria Falls is over a mile long—5,808 feet, to be exact—whereas the American Fall at Niagara measures but 1,060 feet, and the Horseshoe Fall is only 1,230 feet across, or 3,010 feet as measured along the curve. To illustrate the magnitude of the African waterfall, we have depicted against it the skyline of New York from Battery Park to Worth Street. Not a building projects above the crest of the falls excepting only the tower of the Singer Building, which is now in process of erection. To be sure, in comparing Niagara with Victoria, it must be said in favor of the former that the Horseshoe Fall presents an unbroken crest, while the edge of the Victoria is divided by numerous islands into stretches which nowhere exceed 600 feet. At the center is Livingstone Island, and to the left, as you look up stream, is the main fall, while at the right of the island is the Rainbow Fall. Buka Island separates the main fall from the Cascade or Devil's Creek.

Fully as remarkable as the falls themselves is the peculiar formation of the chasm into which the waters pour. Facing the falls, and separated from it by a space of less than 300 feet in width, is a vertical wall of rock presenting a barrier to the flow of water which is unbroken except for a gorge near the center a little over 300 feet wide. It seems as if this wall, which at one time undoubtedly formed the lower terminal of the lake, had been moved bodily back by some giant hand, leaving a deep, narrow fissure into which the waters of the lake fall. Since there is but one outlet from this fissure, and that only 300 feet wide, the depth of water in the gorge must be exceedingly great. The peculiar geological formation may be said to cause the lake or river to flow first on end over the falls, and then on edge through the gorge.

The water pours into the fissure amid clouds of spray, with a deafening roar which may be heard for miles. This has given rise to its native name, Mosi-oa-Tounya, or the Thunder Sounding Smoke. For the same reason Niagara was called by the aborigines the Abode of the Spirit of Thunder. Bearing out the belief of the red man, his pale-faced brother has succeeded in drawing the lightning from this Thunder Spirit. Similarly, the white man expects soon to draw the fire from the Thunder Sounding Smoke, and use it to operate the machinery of the Rand gold fields. In keeping with the size of this giant waterfall, as outlined in the SCIENTIFIC AMERICAN of December 22, 1906, the Victoria power station, when completed, will have an output of 250,000 horse-power at the enormous pressure of 150,000 volts, and will transmit its power 600 miles, or nearly three times as far as any system now in operation.

The Sealed Bonnet Contest of the Automobile Club of America.

What proved to be one of the most interesting as well as successful automobile competitions ever held in the vicinity of New York city was that conducted by the Automobile Club of America during the last four days of last week, and which was known as a "Sealed Bonnet Contest."

In this contest the bonnets, radiators, gear boxes, tools, etc., were sealed and were not allowed to be touched throughout the total distance of 600 miles, which was covered in daily runs out and back of 150 miles each. The first and last day's runs were to Patchogue, L. I., and those on the second and third days were to Danbury and West Haven, Conn., respectively. Almost the total distance was over macadamized roads, but as the contestants were favored with fair weather, this made no particular difference.

No less than 47 cars started in the test on Wednesday, June 19, and 42 of these finished with a perfect score on the afternoon of Saturday, June 22. A Stoddard-Dayton runabout, entered by a private owner, dropped out the first day, owing to the replacing of the nut which holds on the steering wheel. The second day's run was completed with the loss of but one more contestant—the Columbia gasoline-electric touring car—which was obliged to open its bonnet in order to replace a broken valve spring. Three contestants were arrested for speeding at Mt. Kisko by a constable with a rope which he stretched across the road. In view of the fact that the club stationed men with flags at the entrance and exit of each village, thus cautioning the contestants to obey the speed limit under penalty of disqualification if they did not, this attempt to mulct the autoists by the Mt. Kisko authorities should not be passed over lightly. No competition of this character more devoid of racing has ever been held, and the Club will doubtless not allow the constable and justice of the village in question to put upon the contestants the stigma of speeding because of some very slight technical violation.

The cars were divided into three classes according to price. The price limits of these classes were: Class A, $3,000 and over; class B, $1,500 to $3,000; class C, $1,500 and under. Runabouts in class A were required to cover 175 miles a day instead of 150. The average speeds required of the three classes were 17, 15, and 13 miles an hour respectively.

All stops were recorded, and the length of each stop was added to the running time. Tire repairs were the only repairs permissible, and the time taken in making these had to be added to the running time of the cars. A notable feature of the various runs was the fact that there was little or no tire trouble; only two or three cars each day were delayed on this account. The fact that the runs were made over first-class macadamized roads doubtless accounts for the lack of tire trouble. Nevertheless, it is quite remarkable that out of nearly half a hundred cars of all sizes and weights, there should be such a small percentage delayed on account of tires in a series of runs aggregating 600 miles in length.

Altogether there were thirty-seven touring cars and ten runabouts engaged in the competition. Among these were an Aerocar, two American Mors, two Berliets, three Corbins, one Continental, one Columbia, two Darracqs, one Deere, one DeLuxe, an Elmore, a Glide, a Haynes, a Jackson, two Knoxes, four Locomobiles, two Loziers, two Mathesons, two Maxwells, three Moras, an Oldsmobile, a Pierce-Arrow, a Pope-Hartford, a Pope-Toledo, a Royal Tourist, a Rolls-Royce, three Stoddard-Daytons, one Studebaker, a Welch, and two Whites.

It is certainly remarkable that so many standard machines of both domestic and foreign manufacture were able to go through so severe a test with a perfect score; and their performance in this test should do much to influence intending purchasers, who have had

impressed upon them heretofore by their well-meaning automobilist friends the idea that it often costs more to keep a car and run it than the original price of the car itself.

With the test just cited as a sample, the Chicago Motor Club has decided to conduct a similar test on June 28. Three classes are provided for touring cars, and a separate class for roadsters or high-powered runabouts. There will be but one prize in each class, and the car having the least penalization will win this. In this contest, each time the engine is stopped there will be a penalization of 25 points. The bonnet and coil of each car will be sealed, and a penalization of 50 and 25 points respectively will be made for the breaking of these seals. Five points penalization will be given for each minute or fraction thereof spent in making repairs, adjustments, or replacements. Putting water in the radiator will also be penalized. All cars having the engines underneath must be provided with mud aprons, which will also be sealed. There will be no penalties for repairing tires, but the contestants will have to make up any time lost in this manner within a control. A leeway of ten minutes is allowed at each control. There will be five checking stations, and the total distance is 131.6 miles.

In addition to the sealed bonnet contest just mentioned, California automobilists are to have a two days' endurance run from Los Angeles to San Diego on June 27 and 28, and the Quaker City Motor Club is to conduct the reliability run from Philadelphia to Wildwood, New Jersey, July 3. The race meet will be held at the latter place on the Fourth.

INAUGURATION OF WORK ON THE CATSKILL NEW YORK WATER SUPPLY.

On June 21, on the side of one of the mountains to be intersected by the aqueduct, Mayor McClellan cut the first sod of what is probably the greatest municipal engineering work ever undertaken in the history of the world—the Catskill water supply for New York city. At the invitation of the New York Board of Water Supply some three hundred guests, including besides the Mayor, the Comptroller, the Corporation Counsel, the State and Civil Service Commissions, and representatives of various prominent institutions in this city, were taken by steamer to Cold Spring, on the eastern bank of the Hudson River, and were then driven some three miles back into the mountains to the valley of what is known as Indian Creek. Here, after appropriate ceremonies, a silver spade was presented by Commissioner Charles M. Chadwick to the Mayor, who, after turning the sod, announced, "Now I, the Mayor, in the name of the people of New York, declare this work begun."

It was fitting that the work of actual construction should be thus inaugurated by Mayor McClellan; for it is to his appreciation of the grave condition which threatened New York with the terrors of a water famine, and to the energetic and masterly way in which he has used all his influence to push the work through to its present stage, that the present and future citizens of New York will be indebted for this, its most important municipal undertaking. The magnitude of the work will be understood when it is stated that its estimated total cost of $162,000,000 is not far short of the total estimated cost of the Panama Canal. Next to the Mayor, credit should be given to the Commissioners, President J. Edward Simmons, and his fellow Commissioners, Charles M. Chadwick and Charles S. Shaw, for the enthusiasm and energy which they have displayed, and the excellent results achieved during the brief period in which they have been in office. The speech of President Simmons was of an unusually high order, and the motives and purpose of the work were summarized in a passage which we here quote:

"Why do four millions of Americans who compose the greatest municipality of the New World contribute without a murmur all the treasure required for this gigantic enterprise? The answer comes spontaneously to our lips. It has been demanded and ordered by the people for the people.

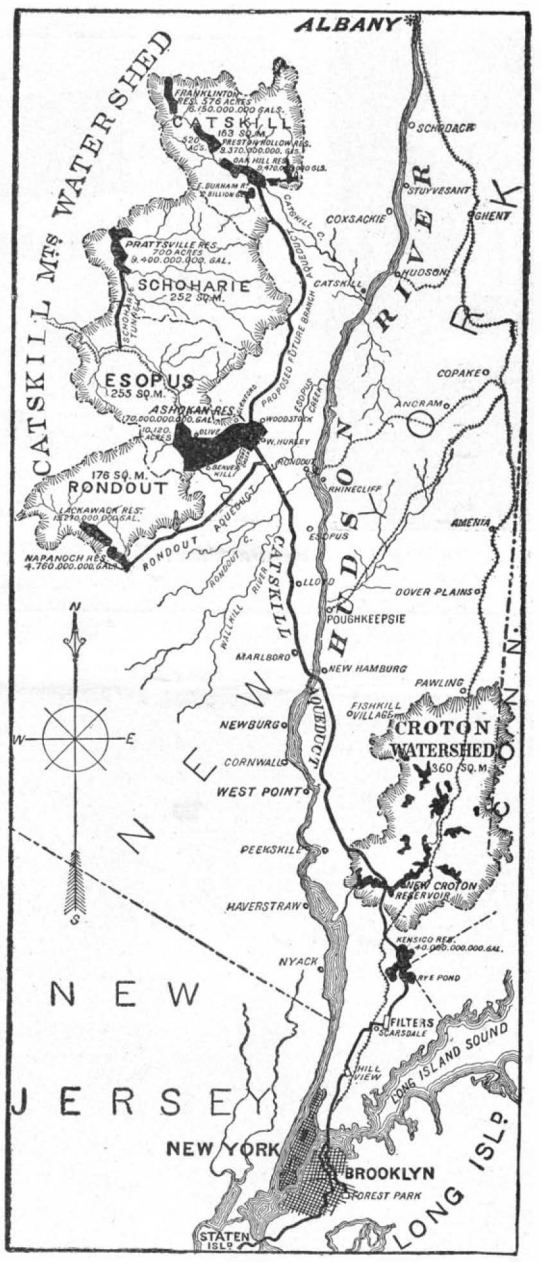
"This mighty aqueduct will take away from no man anything that is needful to him. It will bring the purest and most healthful of all drinks to myriads of our fellow-citizens, both in the present and the future. It will bring to their homes the means of cleanliness and happiness. It will be a safeguard to the household goods of the poor and to the merchandise of the captains of industry."

After the ceremony of turning the first spadeful of earth the Mayor said:

"When I took office on January 1, 1904, I found myself confronted with a possible water famine, and with nothing practical done for its avoidance. The imminence of the peril was appreciated by the few who had studied the matter, but the public at large did not understand its seriousness, nor was there any public sentiment in favor of its speedy solution. Some preliminary work had been done and done well, but that was all. My administration found it necesary to do three things before a new water supply system could be actually undertaken. First, it was necessary to provide an additional borrowing capacity to meet the expenses of the undertaking, by means of a constitutional amendment which had passed the Legislature, but had not been submitted to the people. Second, it was necessary to enact legislation so as to make the powers of the local authorities certain. And third, and most important, it was necessary to arouse public opinion so that the first two obstacles could be removed.

"As the years merge in the decades and the decades in the centuries, when time has thrown its kindly veil over the bickerings and the differences and the quarrels which seem so much to us and are after all so futile and so petty, when friend and enemy, traducer and traduced have passed away, when our very names shall have been forgotten, when this great work conceived in honesty, begun in honesty and completed, God willing, in honesty, shall be administering to the health and happiness of millions yet to come, then God grant that those who shall see it may say: 'It does not matter how they were called who did this thing, or who they were, or what they were, it is enough that they did their duty.'"

The sod was cut on a strip of two and one-half acres



MAP OF NEW YORK CITY'S PROPOSED NEW WATER SUPPLY.

of land which has the distinction of being the first land bought by the city for the new aqueduct.

In selecting a new source of water supply, the engineers realized that the conditions surrounding New York city were exceedingly difficult. To the east it is shut in by the Atlantic Ocean; to the west it is excluded by the laws of New Jersey from tapping any of the water sources of that State. The excellent supply which might have been drawn upon from the sources of the Housatonic River was shut out of consideration because of the location of that river in the State of Connecticut; and hence the city has been driven by its geographical and legal restrictions to the splendid sources of supply which lie in the Catskill Mountains. This water supply is not only abundant, but the water is of most excellent quality. By reference to the accompanying map, it will be seen that four separate districts are to be drawn upon. The first of these is what is known as the Esopus Creek watershed, which has an area of 255 square miles. Its waters are to be impounded by the construction of a great dam 220 feet in height across the valley of the Esopus, at the Olive Bridge site. The dam will create the Ashokan reservoir, 12 miles in length and 2½ miles in width, with a capacity at full level of 170,000,000,000 gallons, and capable of supplying 250,000,000 gallons of water per day. From the dam a huge aqueduct 17½ feet in its largest diameter will be built, partly by the cut-and-cover method and partly in tunnel, which will extend to the westerly bank of the Hudson River at a point between Cornwall and West Point.

It was originally intended to carry the aqueduct in tunnel below the Hudson River at New Hamburg, but the preliminary borings at this and other sites proved that it would be difficult to find a rock sufficiently free from fissures and other imperfections to render it suitable to withstand the enormous pressure of the water at the depth below the river at which it would have to be carried. Borings are now being made near Cornwall at a site where geologists assured the engineers that it would be possible to find a thoroughly sound and suitable rock. The aqueduct passes through the mountain and reaches the westerly slope of the Hudson River at an elevation of 400 feet above tide level. Here a vertical shaft will be sunk until a depth probably of 700 feet below the river surface or 1,000 feet below the level of the aqueduct is reached. The tunnel will then pass beneath the river to connect with another vertical shaft of almost equal depth on the easterly bank of the river. From this point it will be constructed through the mountains until it reaches the new Croton reservoir. Here connections will be made to enable the water to be drawn directly from the Ashokan reservoir into the Croton reservoir, with a view to augmenting the Croton supply until the whole aqueduct from Ashokan to New York city shall have been completed.

From the Croton reservoir the aqueduct will be continued south to Kensico reservoir, which will be enlarged to include Rye Pond, and form an auxiliary storage reservoir at an elevation of 355 feet above mean tide, capable of containing 25,000,000,000 gallons, or sufficient to supply the city at the rate of 500,000,000 gallons for a period of fifty days. About four miles south of Kensico, at Scarsdale, there will be built a large filtering plant, and six miles to the south of this will be another storage reservoir at Hill View. With these two auxiliaries or emergency reservoirs provided, the city will be secured against any sudden interruption of its supply through failure of the 69 miles of aqueduct lying to the north of them.

By the construction of a tunnel of 200,000,000 gallons daily capacity below the East River, Brooklyn and Staten Island will be provided with a supply of 100,000,000 gallons daily, and this aqueduct will terminate in a large reservoir to be constructed in Forest Park. From the point where this tunnel reaches the shores of Long Island, a line of 20,000,000 gallons capacity will be built through Brooklyn and below the Narrows for the supply of Staten Island.

The rate of growth of Greater New York is so rapid that it cannot be many years before the watersheds of the Rondout, the Schoharie, and ultimately of the Catskill rivers will, in turn, be brought into service. The Rondout watershed covers 176 square miles, and would be capable of yielding 130,000,000 gallons daily. This water will be stored in what will be known as the Mapanoch reservoir, from which its waters will be led by an aqueduct into the main Catskill aqueduct a couple of miles below the Ashokan reservoir. Later, the Schoharie watershed will be brought into service by the construction of the Prattsville reservoir, its waters being brought into Esopus Creek by means of a tunnel through the divide. Lastly, the Catskill water will be impounded in several reservoirs located along that stream, and brought into the Ashokan reservoir by an aqueduct whose location is shown on the accompanying map. Altogether, when the whole scheme is completed, New York city will have at command over 700,000,000 gallons daily water supply from the Catskill Mountain watershed, in addition to the 375,000,000 gallons already available in the Croton watershed.

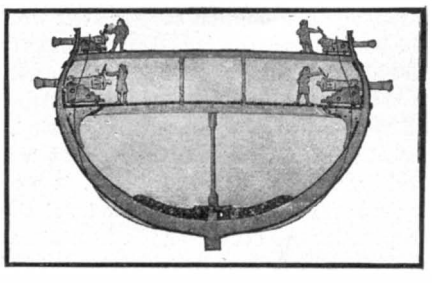
The Current Supplement.

More than 10,000 men are in daily attendance at the largest railway university in the United States. The university is described by Frederic Blount Warren in the current SUPPLEMENT, No. 1643. "False Back Repetition Casting" is the title of an article which will interest the amateur founder. Some practical tests of rubber are given. Several forms of telegraph railroad signaling systems have been proposed, and a number of tests have been carried out. The most recent of these systems, invented by Frank W. Prentice, is described. Walter F. Reid tells how to use waste India rubber. "Bacteria in Cheesemaking" is the title of an essay by Prof. Herbert W. Conn. "The Amateur's Foundry" is simply described by Walter J. May, a well-known English expert. If the same region of the sky is photographed at two epochs, the comparison of the photographs in the stereoscope at once shows what stars have altered in brightness in the interval, for in the photographs the diameters of the star disks vary according to the brightness of the star. This method is described in the current SUPPLEMENT by Dr. Max Wolf, the well-known Director of the Heidelberg University Observatory. The maintenance of the equilibrium in aeroplanes is a subject of vital importance to the aeronaut. Robert W. Goddard shows how the gyroscope may be used for balancing and steering aeroplanes.

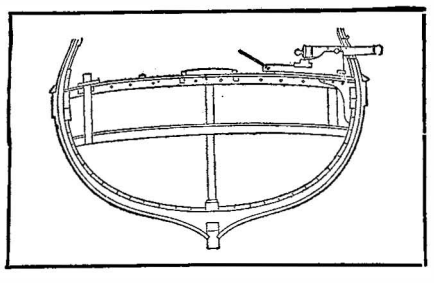
THE VESSELS AND GUNS OF THE OLD NAVY, 1775-1850.

BY DR. CHARLES OSCAR PAULLIN.

The American armed vessels that cruised against the ships of the enemy during the revolutionary war were fitted out by either the federal government, one of the State governments, or by private persons. With the exception of New Jersey and Delaware, each of the States owned one or more vessels. The fleet of Virginia, which consisted of some fifty ships, was the largest, but it was poorly equipped, and rendered little service. The most efficient State navy was that of Massachusetts. It contained sixteen vessels, of which the largest was the frigate "Protector," mounting 26 guns. The largest ship in the State navies was the "South Carolina," mounting 40 guns. The principal fleet of the revolution was that of the privateers. It comprised some 1,200 or 1,500 vessels. They were privately owned, and sailed under letters of marque issued either by the State governments or by the Continental Congress. They were generally small craft. Only a few of them mounted as many as twenty guns—more than one-half of them ten or a less number of guns. The crews of the smaller privateers consisted of fifteen to fifty men.



Section Showing Construction of a Frigate.



Section Through a Sloop-of-War.

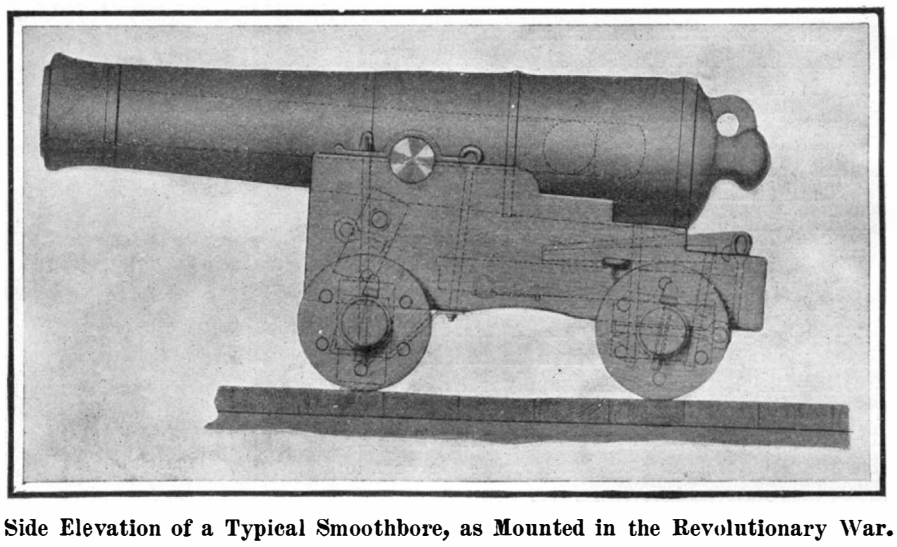
Some eighty or ninety ships belonged to the Continental Congress, the federal government of the revolution. About one-third of these were rated as galleys, half-galleys, or small sailing craft carrying less than ten guns. The galleys and half-galleys were propelled partly by oars. Of the ships carrying more than ten guns, there was one line-of-battle ship, the "America," 74. She never went to sea under American colors. Shortly after she was launched in 1782, our government gave her to Louis XVI. to replace the French ship "Magnifique," which had been accidentally lost in Boston harbor. Eighteen Continental vessels, mounting from 24 to 32 guns, were rated as frigates. The dimensions of one of the largest of the frigates, the "Hancock," 32, were as follows: Length of gun deck 137 feet, keel 116 feet, beam 34 feet, and depth 11 feet; her tonnage was 730 tons. The "Boston," 24, measured 114 feet on the gun deck, 94 feet keel, 32 feet beam, and her depth was 10 feet; her tonnage was 514 tons. The burden of the "Alfred," the first ship in the Continental navy, was only 200 tons. The "Wasp," 8, and "Fly," 8, were still smaller than the "Alfred."

The 74-gun ship "America" was built at Portsmouth, N. H. John Paul Jones was superintending her construction when she was launched in 1782. All but two of the Continental frigates were built in the United States in the chief Atlantic ports to the north of Virginia. The "Deane," 32, was purchased in France, and the "Queen of France," 28, was constructed for the American government at Nantes. The 32-gun frigates were built as follows: The "Raleigh" at Portsmouth, N. H., the "Hancock" and "Alliance" at Salisbury, Mass., the "Warren" at Providence, the "Confederacy" on the Thames River in Connecticut, and the "Randolph" and "Washington" at Philadelphia. The "Bon Homme Richard," 42, the largest ship that sailed under American colors during the revolution, and the flagship of John Paul Jones, was loaned to Jones by the French government. The revolutionary vessels mounted long guns or else guns of moderate length. There were no carronades in the Continental navy. The frigates mounted 12-pounders, 9-pounders, and 6-pounders, and the smaller craft 6's and 4's. A few 18-pounders were in use, and on some of the galleys guns of still larger size were to be found. In the fight between the "Bon Homme Richard" and the "Serapis," the American vessel mounted on her lower deck six long, old-fashioned 18-pounders, on her main deck twenty-eight 12-pounders, and on her forecastle and quarter-deck eight 9-pounders. The "Alliance," rated as a 32, is believed to have carried in her fight with the British brigs "Atalanta" and "Trepassey" twenty-eight 12's and eight 9's. The "South Carolina," of the South Carolina navy, carried an extraordinarily heavy battery for a frigate—twenty-eight 32-pounders, and twelve 12-pounders. This was the heaviest armament mounted by an American vessel during the war.

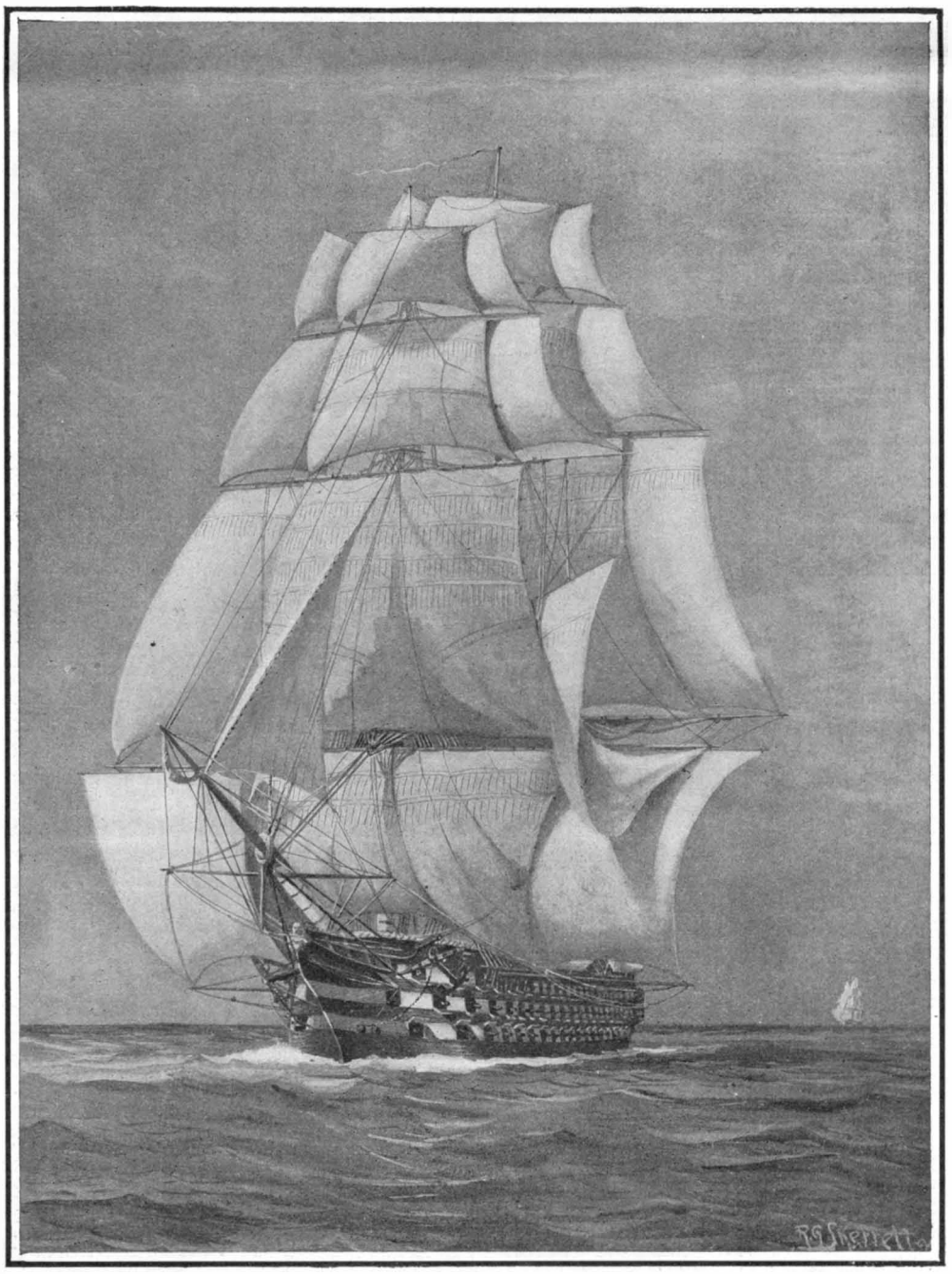
Probably the finest vessel in the revolutionary navy was the "Alliance." She was a fast sailer, and when she visited Europe in 1778 was greatly admired. She was in John Paul Jones's fight off Flamborough Head, but was compelled to play a most ignominious part, owing to the weakness of her captain, Pierre de Landais, an eccentric Frenchman. In 1780 the command of the "Alliance" was given to Capt. John Barry. He was of Irish descent, and next to Jones was the most celebrated sea officer of the revolution. His most famous fight was that of May 28, 1781, when he captured two British naval vessels. This engagement has been describe ' for us by one of Barry's officers:

"Toward evening discovered a sail on the weather bow standing for us, and which, after coming near enough to be kept in sight, hauled to wind and stood on our course. Toward day it became quite calm. After it became light, it appeared that they were an armed ship and a brig about a league distant. At sunrise they hoisted the English colors and beat drums. At the same time the American colors were displayed by the "Alliance." By little puffs of wind we were enabled to get within small hailing distance. At 11 o'clock Capt. Barry hailed the ship, and the answer was 'the "Atalanta," ship of war, belonging to His Britannic Majesty, and commanded by Capt. Sampson Edwards.' Capt. Barry replied that we were the Continental frigate 'Alliance,' commanded by John Barry, and advised him to haul down his colors. Capt. Edwards answered: 'Thank you, sir; perhaps I may after a trial.' The firing then began. But unfortunately there was not enough wind for our steerageway. Being lighter vessels, by the use of sweeps they got and kept athwart our stern and on our quarters, so that we could not bring one-half our guns—nay, ofttimes only guns out astern—to bear on them. And

Gun Deck of 44-Gun Frigate "Santee."



Side Elevation of a Typical Smoothbore, as Mounted in the Revolutionary War.



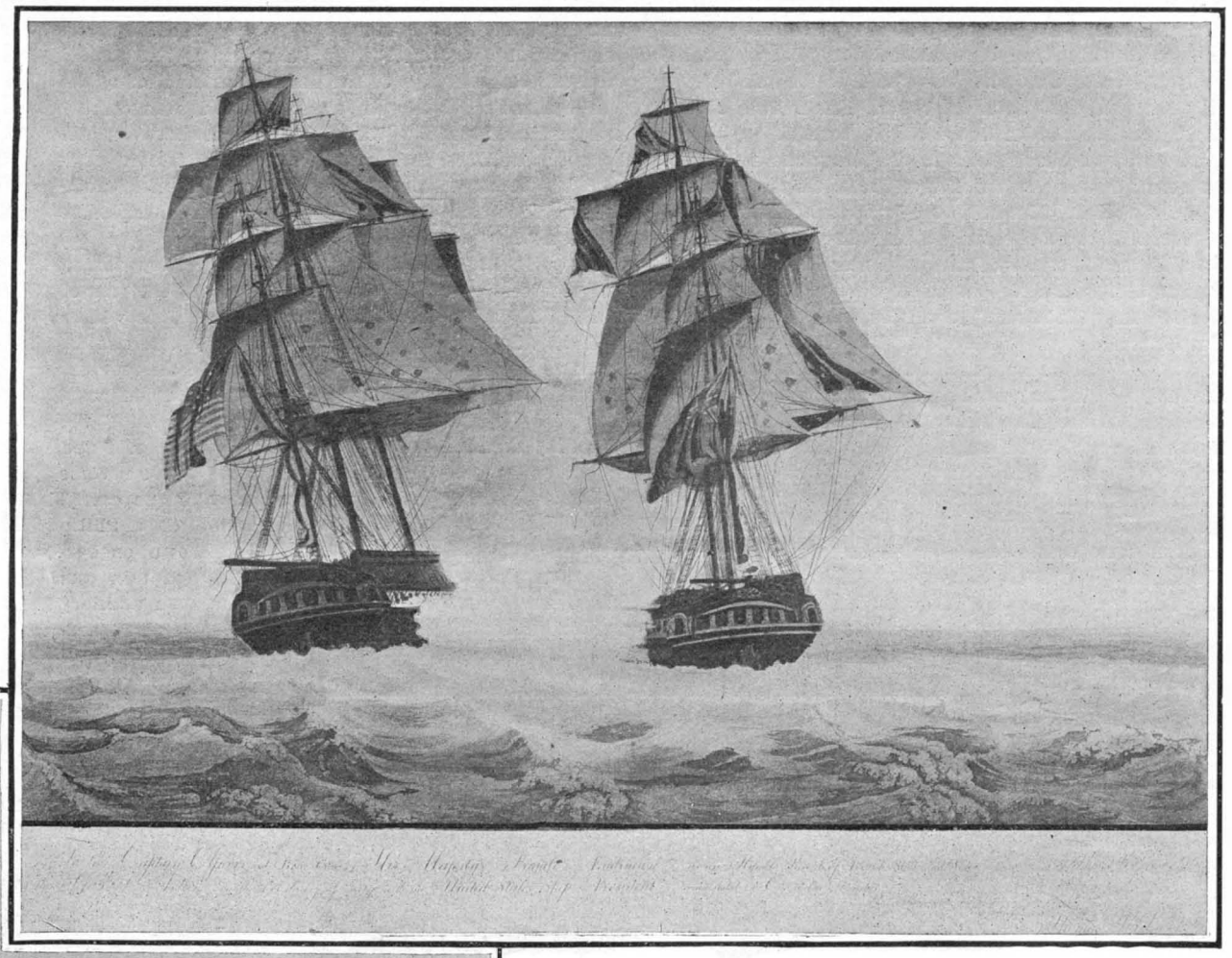
The largest wooden three-decker ever built in America, of 3,241 tons and carrying 120 guns.

First-Class Battleship "Pennsylvania."

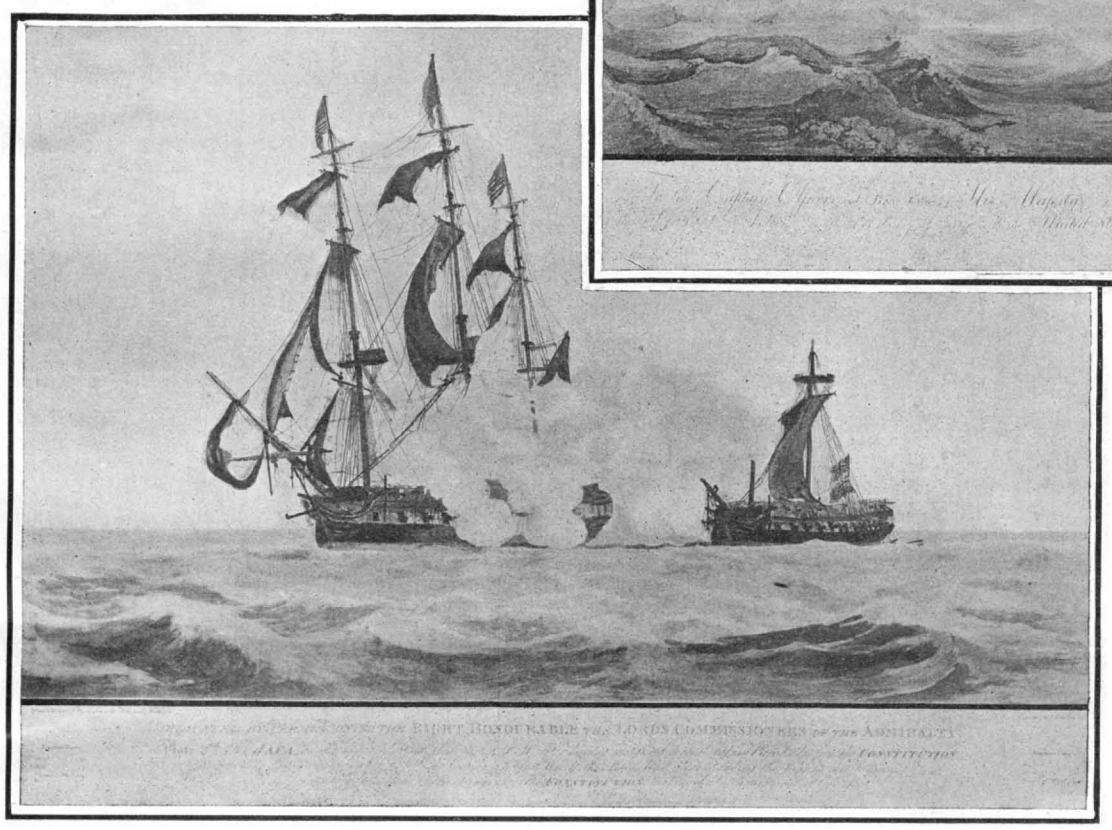
thus we lay like a log the greatest part of the time.

"About 2 o'clock Capt. Barry received a wound by a grapeshot in the shoulder. He remained, however, on the quarter-deck until by much loss of blood he was obliged to be helped to the cockpit. Some time after, our colors were shot away. It so happened that at the same time such guns as would bear on the enemy had been fired, and were then loading. This caused the enemy to think we had struck our colors. They manned their shrouds and gave three cheers. By that time the colors were hoisted by a mizzen brail, and our firing began again. A quartermaster went to the wheel in place of one just killed there. At the same time a small breeze of wind sprang up. A broadside was brought to bear and fired on the ship, and then on the brig, when they struck their colors at 3 o'clock."

After the close of the revolutionary war in 1783 the few ships that remained in the navy were gradually disposed of, and the officers and crews were discharged. The "Alliance" was the last vessel in the Continental navy. She was sold in August, 1785, for $14,400. Her purchasers afterward disposed of her to Robert Morris at a great profit. In June, 1787, she sailed for Canton as a merchantman, being one of the first American ships to make a voyage to China.



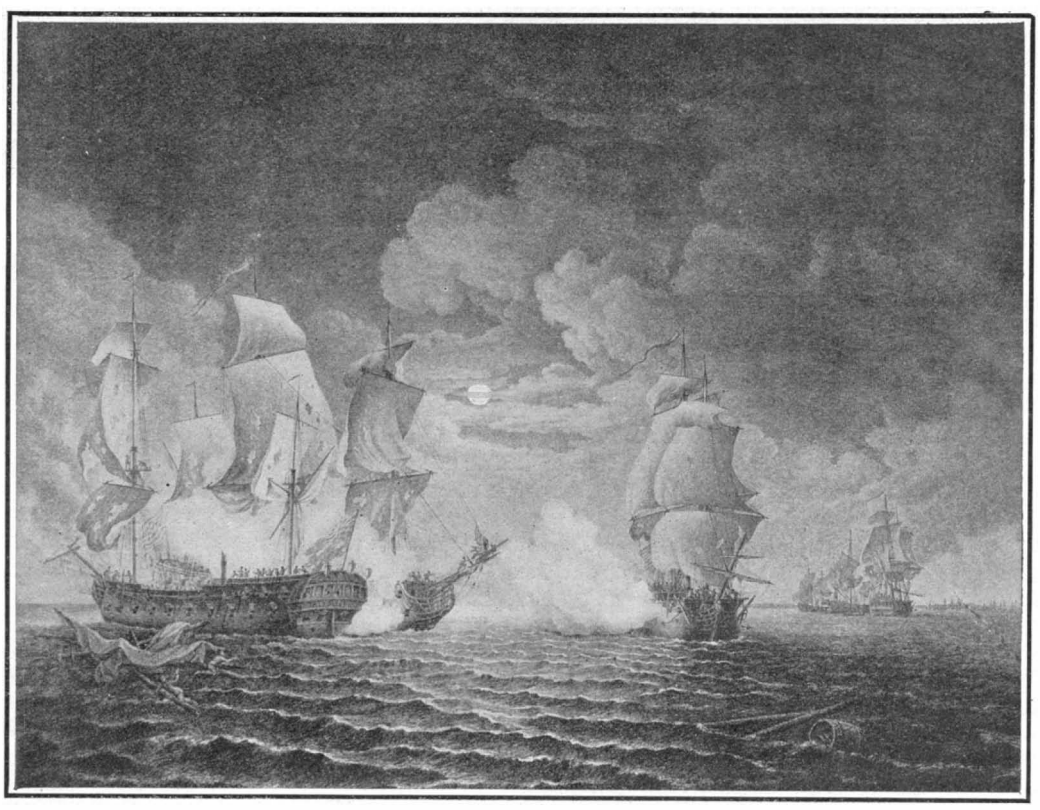
Fight Between the United States Ship "President" and the "Endymion," January 15, 1815.



Capture of the "Java" by the "Constitution," December 29, 1812.

From 1794, when the construction of a new navy was begun, until 1850, when steamships first began to supplant rapidly the sailing ships, the American navy contained some 600 vessels. Of these, about one hundred and eighty-five were sailing vessels of ten or more guns, about twenty were steamships, and the rest were gunboats, galleys, barges, and small sailing craft of less than ten guns. The building of gunboats was a fad of President Thomas Jefferson, and during his administration one hundred and seventy-six of these small craft were constructed, at a cost of $1,584,000. They varied in size. One of average dimensions was 60 feet long, 17 feet wide, and 6 feet deep. They carried one or two large guns, usually 24-pounders or 36-pounders, and from fifteen to forty-five men. The gunboats were adapted only for coast defense. Several of them, however, made the trip across the Atlantic and took part in the Tripolitan war of 1801-1806.

In the early part of the nineteenth century our larger naval vessels belonged to three classes —"sloops," frigates, and line-of-battle ships. These were distinguished from each other by size, the number of guns carried, and the number of decks upon which the guns were mounted. The sloops were rigged as sloops, brigs, schooners, or ships. Their tonnage was about 500 tons. They mounted sixteen to twenty-two guns, on one deck, and carried 140 to 175 men. The "Peacock," "Frolic," "Wasp," and "Hornet," which were in the navy during the war of 1812, were of this class. The frigates were ship-rigged vessels, of 800 to 1,600 tons burden. They mounted 30 to 55 guns, on two decks. Well-known vessels of this type were the "Constitution," "United States," and "Constellation." The tonnage of the line-of-battle ships was 2,200 to 3,200 tons. They mounted 74 to 120 guns, on three or more decks, and carried 800 to 1,100 men. As their name indicates, they were intended to bear the shock of battle between opposing fleets.



Capture of the "Serapis" by Paul Jones in the "Bon Homme Richard," September 23, 1779.

VESSELS OF THE OLD NAVY, REPRODUCED FROM CONTEMPORARY PRINTS.

After the building of the "America" during the revolution, no line-of-battle ship was constructed until the war of 1812, when five of them were placed upon the stocks: the "New Orleans" and "Chippewa," at Sacketts Harbor, on Lake Ontario; "Independence," at Boston; "Franklin," at Philadelphia," and "Washington," at Portsmouth, N. H. The "Independence," which went to sea in 1815 as the flagship of Commodore William Bainbridge, was the first line-of-battle ship to fly the American colors. The "Washington" was placed in commission in 1816, and the "Franklin" in 1817 or 1818. The "New Orleans" and "Chippewa" were never launched. In 1883 the "New Orleans" was sold upon the stocks for $527.

Shortly after the war of 1812, the construction of nine new line-of-battle ships was begun. Of these, the first to be completed was the "Columbus." She was launched at the Washington navy yard in 1819. In 1820 three other ships were launched—the "Ohio," at the New York yard; the "North Carolina," at the Philadelphia yard; and the "Delaware," at the Norfolk yard. The next vessel to be completed was the "Pennsylvania." She was launched at Philadelphia in 1837. The "Vermont," building at Boston, was not completed until 1848; and the "Alabama," building at Portsmouth, N. H., not until 1864, when her name was changed to the "New Hampshire." The "New York" was destroyed on the stocks at Norfolk in 1861 by the Unionists when they abandoned the Norfolk navy yard, and the "Virginia" was sold on the stocks at Boston in 1874.

The number of line-of-battle ships in the old navy, all told, was fifteen. The size of these vessels may be seen from the dimensions of the "Ohio." She was 198 feet long, 54.6 feet beam, and 22.5 feet hold. The largest of these vessels was the "Pennsylvania." She mounted 120 guns. Her tonnage was 3,241 tons. Her complement of officers and men was 1,100. Her cost of construction was $694,500. The

cost of the line-of-battle ships of our navy usually varied from $425,000 to $550,000. President John Quincy Adams, who went aboard the "Pennsylvania" in 1827, wrote that she was "said to be the largest ship that will float upon the ocean. She is built chiefly of live oak, and looks like a city in herself."

The first 44-gun frigates in the American navy, the rate next in size to the line-of-battle ships, were the historic vessels "Constitution," "United States," and "President," whose construction was begun in 1794. No additional vessels of this rate were built until the war of 1812, when five of them were placed upon the stocks—the "Plattsburg" and "Superior," at Sacketts Harbor, N. Y.; the "Guerrière," at Philadelphia; the "Java," at Baltimore; and the "Columbia," at Washington. The latter vessel was burned by order of the Secretary of the Navy when the British were advancing on the capital in August, 1814. The "Plattsburg" was never completed. The "Superior" was the largest naval sailing ship ever on the Great Lakes.

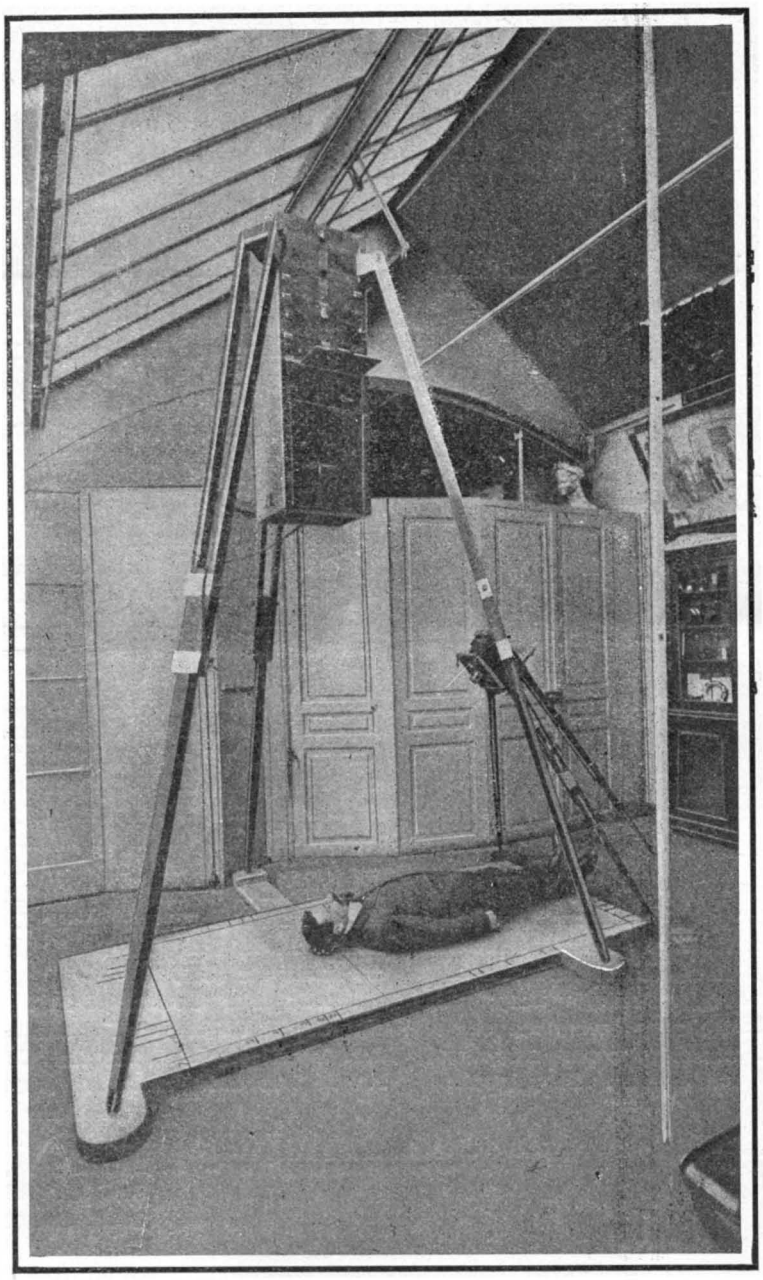
After the war of 1812 the construction of nine 44-gun frigates was commenced—"Potomac," "Brandywine," "Columbia," "Cumberland," "Savannah," "Raritan," "St. Lawrence," "Santee," and "Sabine." The completion of several of these ships was long delayed. Two of them were still on the stocks in 1850. About 1828 the "Hudson," 44, was purchased, and in 1841 the "Congress," 44, was launched. Altogether the old navy contained nineteen 44's. They were very serviceable and efficient vessels. During the war of 1812 the 44-gun frigates were the largest vessels in the navy, and they were usually successful in their engagements with the British vessels. For frigates they were very heavily built and strongly armed. Their cost of construction was $300,000 to $430,000. Their size may be judged from the dimensions of the "Constitution." She was 175 feet long, 43.6 feet beam, 14.3 feet hold, and 21 feet draft forward.

Several historic vessels of the old navy were rated as 36's. This was the rating of the "Constellation," "Chesapeake," "Philadelphia," and "Macedonian." The "sloops" were divided into first, second, and third class, rating respectively 20, 18, and 16 guns. The sloops tended to increase in size. The "Saratoga," one of the later sloops, carrying twenty-two guns, had a tonnage of 882 tons. Her complement of men was 210. Her dimensions were as follows: Length 150 feet, beam 36.9 feet, and hold 16.6 feet. A 20-gun sloop cost about $170,000.

During the war of 1812 our naval vessels mounted two kinds of guns, the long gun and the carronade. The former was very long and thick-barreled in comparison with its bore. It possessed great range and penetrative power. The carronade was introduced into the British navy in 1779, and into the American navy about 1798. It was a short, light gun; it had a large caliber, but a short range; it had little penetrative, but great smashing power. In the war of 1812 our 44-gun frigates were underrated. They usually carried fifty-two or fifty-four guns. These consisted of thirty long 24's on the main deck, two long guns as bow chasers, and twenty or twenty-two carronades, 32-pounders or 42-pounders. The brig-sloops carried 24-pounder or 18-pounder carronades. Long 12's and 18's were common. The schooner "Nonesuch," an active cruiser on the Southern coast, mounted long 6's and 12-pounder carronades. Generally speaking, the American ships were better built and better armed than the British ships of the same classes. During the war a third kind of gun, the columbiad, was coming into use. In size it was intermediate between the long gun and the carronade. The projectiles in common use at this time were solid shot, shrapnel, canister, bar shot, and chain shot. There were no explosive shells used in the navy.

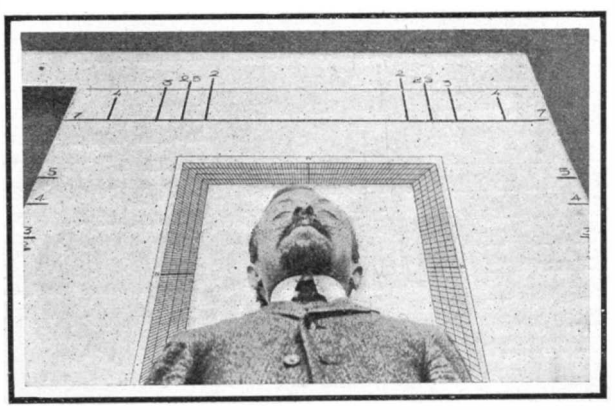
The principal sea duels of our sailing navy during the nineteenth century were fought during the war of 1812. The latter part of the year 1812 and the winter of 1813 will ever be memorable in our naval annals. The five naval engagements of this period all resulted favorably to the Americans. The "Constitution" captured the "Guerrière" and the "Java"; the "Wasp," the "Frolic"; the "United States," the "Macedonian"; and the "Hornet," the "Peacock." The first severe reverse of the Americans was the capture of the "Chesapeake," Capt. James Lawrence, by the "Shannon," Capt. Philip Vere Broke, in May, 1813. This well-known engagement, off Boston, in which the American captain was killed, lasted but a few minutes. It was an artillery fight at close range, and was decided before the boarding of the "Chesapeake" took place, as the result of the superior discipline of the British crew. The American ship was manned with raw recruits. The engagement between the "Constitution," Capt. William Bainbridge, and the "Java," Capt. Henry Lambert, off the coast of Brazil, lasted about three hours. Here the maneuvering of the ships played a most important part. The "Java" was too much injured to be worth taking to the United States. Bainbridge therefore ordered her to be burned.

A typical line-of-battle ship of our navy of the date 1820 mounted thirty-two long 42-pounders, thirty-four long 32-pounders, and twenty-two 42-pounder carronades. The weight of its broadside was 1,710 pounds. The long 42-pounders had great range and penetrative power. About 1845 the "Pennsylvania," the largest ship in the navy, mounted sixteen 8-inch guns and one hundred and four 32-pounders. During the early part of the nineteenth century there was a "chaos of calibers" in our navy. For instance, a line-of-battle ship might require "three sizes of shot and four classes of full charge, with as many reduces as caprice might suggest." A uniform caliber throughout the fleet became the ideal of the naval officers of both this country and Europe. This ideal was in large part realized in France in 1829, in England in 1839, and in the United States in 1845. In the latter year the Navy Department adopted the 32-pounder as the unit caliber of our navy, and directed that in the future the batteries of our naval ships should consist of 32-pounders and 8-inch shell guns. The latter type of ordnance had come into use in our navy about 1840, when the Paixhans shell guns had been introduced. The improvements that were made in ordnance during the decade preceding the civil war again complicated our naval batteries, and brought into use the 9-inch, 10-inch, and 11-inch Dahlgren guns, 64-pounders, and rifled cannon.



The New Bertillon Apparatus for Photographing Suspected Criminals for Identification.

A Photograph Surrounded by Perspective Scales.



A Photograph Taken Obliquely.

BERTILLON'S NEW SYSTEM OF ANTHROPOMETRY.

BY JACQUES BOYER.

Dr. Bertillon, chief of the department of identification of the Paris prefecture of police, has devised a photographic apparatus, by the aid of which valuable evidence can be obtained in the investigation of crimes. The new method is based on an ingenious application of the laws of perspective to photography.

The apparatus, invented by Bertillon and constructed by Lacour, furnishes an elegant solution of the following problem: Given an object of a thickness not exceeding 40 centimeters (16 inches), with its median plane at a fixed distance (2 meters or about 6½ feet) from the lens, it is required to make photographs of the object on various scales of dimensions, without moving the camera or displacing the optical center of the lenses, so that the real dimensions of the object can be calculated from measurements of the photographs. Theoretically the problem is simple, but in practice it is complicated by several difficulties. In the first place, in order to obtain a number of photographs on different scales of an object placed at a fixed distance from the camera, it is necessary to use an equal number of lenses, or combinations of lenses, of different and appropriate focal lengths. The change of the entire combination for each change in focal length would involve great expense for lenses as well as probable displacement of the optical center.

In Bertillon's apparatus as constructed by Lacour the back lens remains fixed and may be combined with any one of six front lenses of graduated focal length, without displacing the optical center of the entire combination, which in each case is anastigmatic and perfectly corrected, with a depth of focus of about 16 inches. Hence, as the focal center is a fixed point of known position, the compound lens may be treated, in calculation, as if it were reduced to this point, and the distance required can be computed very simply by means of the well-known elementary formula $p = f(g + 1)$, in which p is the distance between the object and the optical center of the lens (2 meters in this case), g is the ratio of the dimensions of the object to those of its image, and f is the focal length of the combination employed to produce that image. Consequently the reduction (or magnification) can be computed if the focal length is known, and *vice versa*. For example, let us suppose that we wish to obtain a photograph of dimensions 1/5 of those of the object. In this case the formula becomes $2 = f(5 + 1) = 6f$, whence $f = 2/6$. The required focal length, therefore, is 2/6

meters, or 33 centimeters. M. Bertillon has adopted the following scale of reduction: 1/7, 1/5, 1/4, 1/3, 1/2.5 and 1/2 corresponding to the focal lengths 25, 33, 40, 50, 57 and 67 centimeters, or about 10, 13, 16, 20, 23 and 27 inches.

Each of the movable front combinations is marked with the focal lengths and the reduction which it produces when combined with the fixed back lens, thus: focus 25 centimeters, reduction 1/7. The camera, which is mounted with its axis vertical as shown in the illustration, is a large rectangular wooden box supported by three legs. In one side are six slots at distances from the optical center corresponding to the focal lengths of the six combinations of lenses, and the plate holder, measuring 24 by 30 centimeters (about 10 by 12 inches) is inserted in the slit corresponding to the combination used.

The optical center is exactly 2 meters above a fixed horizontal plane, the plane of reference or median plane, which is itself 20 centimeters (8 inches) above the floor. Hence, as the lens has a focal depth of 40 centimeters it will give a sharp image of any point within a distance of 20 centimeters above or below the median plane.

Portions of the object situated above this plane and consequently within less than 2 meters of the lens will, of course, be less reduced than equal areas of the plane of reference. It has been determined that the scale of dimensions increases by 1/100 for each 2 centimeters of elevation, between the limits of 180 and 220 centimeters from the lens. Hence, if the photograph is surrounded by perspective scales, as shown in one of the illustrations, the real dimensions of a part of the object in any plane parallel to the photograph can be computed from measurements of the corresponding part of the picture. Thus the photographs possess the valuable properties of the diagrams of descriptive geometry and orthogonal projections. The method appears susceptible of numerous applications, especially to anatomy and natural history. In photographing objects smaller than the human head some such series as 1/2, 1, 2, 3, 4, and 5 diameters might be employed, and the fixed distance might be made less than 2 meters in order to diminish the space occupied by the apparatus.

A NOVEL APPARATUS FOR DEMONSTRATING ATMOSPHERIC PRESSURE.

BY DR. ALFRED GRADENWITZ.

Mr. B. Rheinisch, an engineer living in Görlitz, Germany, has for some time been engaged in systematic investigations on the upward pull exerted by the atmosphere, with a view to utilize atmospheric pressure for the lifting of loads.

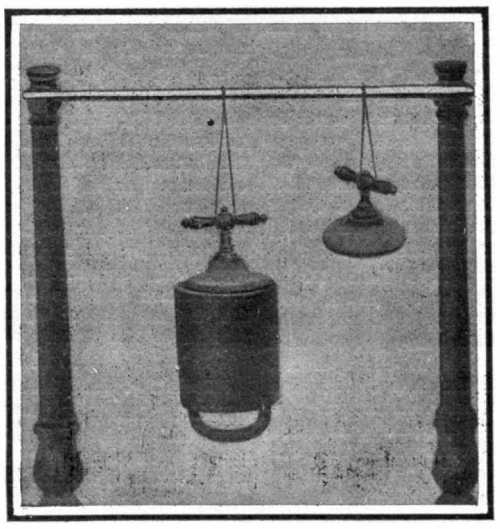
Special attention was paid to the specific weight of all animal bodies carried by the air, such as birds, beetles, and butterflies, and constant ratios between the volume and weight (within certain limits) were given in these three classes of bodies. While a full account of the scientific results reached in this connection is reserved for a future article, the first practical achievement was the construction of what the experimenter calls the "Görlitz pneumatic disks." These disks are intended to interest scientists in the investigation of the displacement of air while affording an illustrative demonstration of the essence and effects of the invisible force due to atmospheric pressure. Owing to its extreme simplicity, the apparatus can be advantageously substituted for the classic Magdeburg hemispheres designed by Otto von Guericke.

Mr. Rheinisch uses two flat, elastic segments of a hollow sphere which are slightly compressed against each other, thus displacing any air contained in the intervening space. Each segment is supplied with a suitable handle, which is of great assistance in making experiments. After discontinuing the compression, the experimenter has practically an absolute vacuum between the two segments of the apparatus.

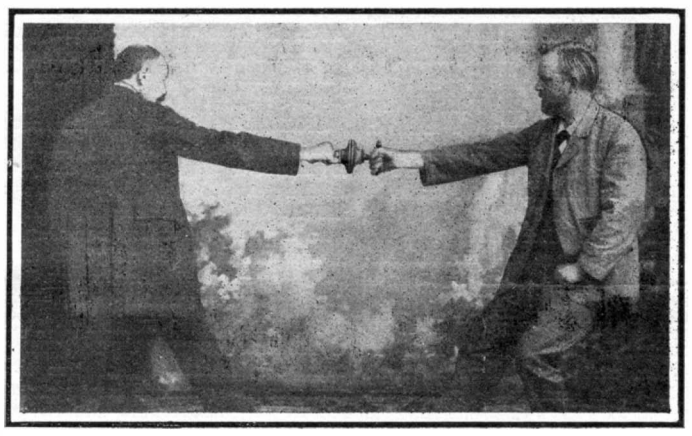
The two halves of the apparatus can be separated with difficulty by two men seizing the handles and exerting their strength to the utmost. If the disks are compressed against a smooth surface, each can be loaded with a weight of 110 pounds by a pull acting at right angles to the surface, no matter whether the load is applied in a downward, upward, or lateral direction. In the case of two elastic disks applied to the varnished wooden surface of a door frame, the charge can be represented by the weight of a grown man loading each handle with 99 to 110 pounds, while a child will be able with its weight to load one handle.

The experimenter further used marble blocks, 22 to 66 pounds in weight, and polished on one side. It was especially interesting to note how awkward were those lifting the stones from the ground without the pneumatic disks, while with the use of the disks the more comfortable position for handling the block was found to be of great advantage.

It is supposed that these disks will be used to replace ordinary gymnastic implements, because of the ease with which they are fitted to ceilings or door-frames, leaving no marks, while fully capable of bearing the weight of a grown person. The German Museum of Masterpieces of Science and Industry, which has been recently opened in Munich, is exhibiting these disks. Many schools have adopted this simple apparatus for the demonstration of the working of atmospheric pressure, thus dispensing with the use of an air pump. We are informed that the inventor is communicating with a number of foreign governments, offering his apparatus, free of patent obligations, in the interest of scientific investigation.



The Görlitz Pneumatic Disks.



Separating the Two Segments Held Together by Atmospheric Pressure.

Disks Attached to Polished Surface, Supporting the Weight of a Boy.

A NOVEL APPARATUS FOR DEMONSTRATING ATMOSPHERIC PRESSURE.

Eggs Without Shells as Freight.

Russian exporters, to avoid an excessive freight on eggs as well as to avoid loss from breakage and from spoiling by heat, ship them without the shell, i. e., broken, and the contents put up in air-tight block tin boxes, with or without salt, according to the taste of the customer. Each box contains several eggs, and is sold by weight, the size running from half a kilogramme up to a *pud* (some 16 kilogrammes). The price of the latter is 5 rubles. For use in cooking and for a limited time, these tinned or preserved eggs seem to answer very well; that is, on the Continent, for England doesn't take kindly to them. London, for instance, which buys large quantities of Russian eggs, pays 8 rubles per *pud* for them (against 5 for the preserved eggs), besides the weight of the shells and the extra freight tariff on eggs. Each block-tin box of "conserved" eggs, whether it be of half-kilo (a kilo is a little over two pounds) or 2 *pud* size, must bear the date and hour of its closing, thus guarding against getting stale eggs. The amount of eggs put up in boxes and annually exported is enormous and constantly growing.—National Druggist.

Paper Pinions.

The driving of machinery by means of gear wheels is rapidly extending, the three chief factors in the development being the increasing use of electric motors, the tendency to save every inch of space occupied by machinery, and the greater attention now paid to the prevention of variation in speed and loss of power.

Where belts are used for driving it is impossible to avoid "slip" with consequent undue wear and tear, loss of power and great variations in speed. Gear wheels give a positive drive with no loss in speed between the driver and driven, and if properly designed and constructed the wear and tear and loss of power is extremely small.

Noise is the chief objection to driving by means of gear wheels, and although this objection has to a great extent been overcome by the use of rawhide pinions which gear with spur wheels having machine-cut teeth, these pinions cannot be considered as finally solving the problem, because under the most favorable conditions their life is comparatively short and they must be protected from moisture, oil, and changes in temperature—three difficult things to avoid in ordinary practice. In consequence of these difficulties experienced, a British firm began experimenting with different materials, and found that pinions made from a high-grade Manila paper were the best available. The paper after being cut into blanks was subjected to the requisite pressure in 1,000-ton hydraulic presses, and the result is a paper pinion that has the strength of a cast-iron gear of the same dimensions.

Different from the rawhide pinions, those made of paper are not subject to variations of temperature and other untoward conditions. A paper pinion is more elastic than one of cast iron, and it is even lighter in weight—i. e., 23 cubic inches equal 1 pound—than rawhide; consequently it has a very decided advantage over either of these gears. When in operation there is no vibration, and there is a total absence of the ringing sound so prevalent in metal gears when they become a trifle worn. After working a short time and being lubricated with graphite, the compressed paper assumes a highly polished surface, which reduces to an appreciable extent the friction between the paper and the metal teeth.

A paper pinion is very simply manufactured by compressing the paper between flanges of hard brass, gun metal, or steel; in the smaller sizes the flanges are held up to their work by suitably spaced rivets, and in the larger sizes by special steel studs with conical heads countersunk.

Prof. Pickering Elected a Member of the Royal Society.

Dr. Edward Charles Pickering, the well-known Director of Harvard College Observatory, was elected June 6 a foreign member of the Royal Society of London, for his signal contributions to astronomical knowledge. The importance of the election may be gathered from the fact that only fifty foreign members have thus far been elected to the Royal Society, a very jealously-guarded list. Those in America who are already foreign members are Simon Newcomb, Alexander Agassiz, George William Hill, and Albert A. Michelson.

In 1886 the Royal Astronomical Society of London awarded Dr. Pickering its gold medal for his photometric work in connection with astronomy.

Prof. Pickering was born in Boston in 1846, and was graduated from Harvard in 1865 with the degree of Bachelor of Sciences. He started his pedagogic career as an instructor in mathematics in the Lawrence Scientific School of Harvard, which post he held from 1865 to 1867. From 1867 to 1877 he was professor of physics at the Massachusetts Institute of Technology, which chair he relinquished to assume the directorship of the Harvard College Observatory, a post he still holds. He has received many academic and honorary degrees from many institutions, notably California, Michigan, Chicago, Harvard, and Victoria (England). Besides two Royal Astronomical Society medals, he has also received the Rumford and Draper medals.

From 1893 to 1905 the tractive power of passenger locomotives in the United States has increased from 15,250 pounds to 24,648 pounds, an increase of 55.6 per cent.

RECENTLY PATENTED INVENTIONS.

Pertaining to Apparel.

SAFETY-PIN.—W. STRAYER, Axtell, Kan. This invention relates to certain improvements in safety pins adapted for general use but more particularly adapted for use in securing any suitable attachment to the person. It may be made in any convenient size or shape. It cannot be opened by pressure alone, nor become accidentally unfastened.

Electrical Devices.

ELECTRIC HEATER.—J. S. REYNOLDS, Santa Barbara, Cal. In the present patent the invention has reference to electric heaters, the inventor's more particular object being to improve the general construction of the heater and more particularly to provide an improved manner for mounting the heating wire.

ELECTRIC CONTROLLER.—R. VAN R. SILL, Newark, N. J. The object of the invention is to provide a controller, more especially designed for use on electric street cars and other electric motor vehicles, and arranged to insure long life to the contact members and to provide an exceedingly strong contact between the said members for the proper transmission of electricity.

ELECTRICAL CONTACT-JOINT.—R. H. WAPPLER, New York, N. Y. Mr. Wappler's more particular object is to produce a type of joint suitable for use in connection with miniature lamps employed in surgery, dentistry, watch-making, and various other professions and avocations in which it is necessary to manipulate the lamp by hand, or to secure it upon the operator's head, as the case may be.

Of Interest to Farmers.

CORN-HARVESTER.—F. D. WILSON and A. D. WILSON, Ottumwa, Iowa. In operation the harvester is driven up the row with one horse between the unharvested corn and the row being harvested, and the others on the outside of the row being harvested, thus bringing stalks in the row into position to be engaged by conveyer chains. These pass the stalks backwardly toward the vertical rollers at the rear which are separated to allow the stalk to pass but not the corn thereon. Means provide for snapping off the ears and knocking them into a conveyer, stripped stalks passing between the rollers. The latter yield for the passage of larger stalks or slight obstructions.

SEED-PLANTER AND FERTILIZER-DISTRIBUTER.—C. E. LITTLEFIELD, Jesup, Ga. A purpose of the invention is to provide a combined planter and distributer which can be used for continuous sowing, drilling, or for planting seed at desired distances apart, and which will be simple and light of draft, and whereby also two kinds of seed can be planted at the same time from the same machine at desired intervals apart.

STONE-PICKER.—G. L. HOLLIDAY and I. S. HAWKS, Curtiss, Wis. This machine is adapted to remove stones from farm land as it is pulled along, and load them into an auxiliary cart coupled to the rear of the machine, and it can be uncoupled when loaded and driven to the desired dumping ground, thereby dispensing with the labor entailed in such machines as dump stones in piles thereafter to be re-loaded before being carted away.

Of General Interest.

TONSILLOTOME.—E. E. STRAW, Marshfield, Ore. The object of the inventor is to provide cutting blades to remove any desired amount of tissue at a single cut, to provide means for adjusting the blades at any angle relatively to the handles operating the blades, and also means for detaching one blade from the other.

STAR-FINDER.—J. T. ROGERS, New York, N. Y., and W. H. RIDINGS, Milwaukee, Wis. This finder is more especially designed for the use of mariners and others, and arranged to enable a person to tell at a glance which stars are most favorably located at a given time for making observations, without requiring tedious calculations; to give the shortest formula for working out longitude and latitude by the simultaneous altitude of two different stars, and to find the deviation of the compass by the bearing of stars, planets, or moon.

CLOSURE.—F. H. PALMER, New York, N. Y. The object of the improvement is to provide an internal closure for the necks of bottles, jars and other packages, and arranged to hermetically close and seal the package in a very simple manner and with economical means. Means enable the prying of the closure out of the bottle when desired.

AERIAL VESSEL.—L. D. MERRICK, New York, N. Y. One of the purposes of the invention is to combine in one vessel the aeroplane and balloon systems in such manner that the two will co-operate and be under the complete control of the operator, and so that the frame of the vessel may be made of exceedingly light material, timber for example, and yet be safe and strong and capable of all the necessary elasticity.

COMBINED EASEL AND PLATE-HOLDER.—S. MCMICHAEL, Newark, N. J. An object in this case is to provide a device which can be quickly, conveniently and economically secured or removably applied to any object capable of being supported by an easel, or which is to be suspended from a support, and furthermore to so construct the device that it may be readily adapted to either of such uses without dismemberment.

ANCHOR-PROJECTILE.—E. MINGUS, Marshfield, Ore. The projectile has in all respects the outward formation of the ordinary projectile, but with arms forming part of the periphery of the projectile, designed to fly outward due to the action of an attached line as the projectile is shot and engage in the earth or other matter in which it becomes embedded, thereby forming an effective anchoring means.

THAWING-POINT.—J. H. LAMLEY, Tacoma, Wash. This invention pertains to thawing-points, such as are used in placer mining for gold. These points are used in frozen earth to a great extent, and are provided with means for conducting steam to the forward end or tip of the point, which effect a thawing of the ground as the point is driven in. The object is to produce a point having means for attaching the hose to the body.

TABLE.—H. H. LEVY, New York, N. Y. This table is particularly for use in manicuring operations or for the use of chiropodists, the object of the invention being to provide a table, on the side opposite to the operator, with a rocking rest for the arm or leg of a person being operated upon, thus not only relieving the person from tiresome annoyance, but making it more convenient for the operator.

KODAK-FILM.—J. B. KETCHUM, Joplin, Mo. The film is for use in a camera having a ground glass focusing plate across which the film is passed. An opening is provided in the film or its web, which may be brought into position over the ground glass; in this way one is enabled to focus an image on the ground glass without removing the film from the camera. The invention prevents tearing the edges of the focusing opening.

NON-REFILLABLE BOTTLE.—I. I. KREMER, New York, N. Y. An improved plug is adapted to be secured within the mouth of a bottle, whereby the latter is prevented from being refilled. The plug is unremovable and its mechanism is so constructed that liquid may readily flow out of the bottle through the plug, but impossible for liquid to be forced into the bottle. Insertion of wire or other tool is also impossible.

PORTABLE MOLD.—W. L. HART, West Liberty, Ill. Especially that type of mold in which the side walls are removed when the molded block becomes firm enough to stand, is improved by the invention. The side walls of the mold may be removed by simply tipping them to one side and without raising the structure to a height above the molded material. The walls may then be employed upon a second base plate or pallet.

LOOSE-LEAF INDEXED LEDGER.—J. F. GLOE, Manning, Iowa. The invention is in the nature of a form of ledger known as loose leaf ledgers, in which removable and interchangeable leaves are firmly held together in a temporary mechanical binder. The object is to make the ledger self indexing and capable of indefinite extension and to facilitate the reference to the various accounts, thus saving much valuable time.

VENTILATOR.—J. F. BOWES, North Adams, Mass. This ventilator is such as those ordinarily removably placed in window openings of buildings, cars, etc., and which will automatically operate to close and shut off a draft of air on blowing therethrough. This is done by swinging two or more sheets of thin material within the opening of the ventilator frame, these being slightly spaced apart and having other openings, whereby as the sheets are blown together, the ventilator is automatically closed, and when separated, is likewise opened.

Hardware.

TUBE EXPANDING AND BEADING TOOL.—W. MCCORMICK, Hillyard, Wash. Means provide for expanding and beading the tubes of boilers into the tube sheet. One object of the invention is to provide means whereby the pin may be constructed of greater strength and the beading tool more centrally arranged to eliminate the jarring effect when in operation. It relates to improvements in the tube-expanding and beading tool described and claimed in a former U. S. patent granted to Mr. McCormick.

HAMMER.—S. S. STUHAG, New York, N. Y. The aim of the improvement is to produce a hammer having means for holding the nail so as to start it in the wood without necessitating that the nail be held in the fingers when the first blows are struck. It is especially useful in facilitating the application of nails in inaccessible places such as a corner.

WRENCH.—G. H. TATGE, Randolph, Neb. The object in this instance is to provide a wrench more especially designed for screwing up or unscrewing the nuts on the teeth of threshing machine cylinders. By using a separate handle for turning the shaft the wrench can be conveniently manipulated in inaccessible places in which only a partial turning of the shaft at a time is permissible until the position of the handle is changed in the eye.

Heating and Lighting.

OIL-RESERVOIR FOR LAMPS.—C. T. WHIPPLE, Glens Falls, N. Y. The invention is especially adapted for use in connection with lamps, oil stoves or the like, which are intended to be removed from place to place, and which are liable to be accidentally overthrown. The device will not permit oil to flow or leak from the reservoir when the lamp to which it is attached is overturned, thereby preventing ignition or explosion.

GAS-BURNER.—B. F. JACKSON, Jersey City, N. J. In the present patent the invention has reference to gas burners, and the improvement has for its object the provision of means for thoroughly mixing gas and atmospheric air in the proper proportion to produce quick and complete combustion of the gas.

BASE FOR STOVES OR RANGES.—M. F. ALLEN, Nashville, Tenn. The present invention provides a base for sheet metal stoves and ranges, arranged to increase the strength and durability of the body of the stove or range, to dispense with separate base bands, and to render the manufacture of the stove or range very economical. It relates to range construction such as shown and described in the Letters Patent of the U. S. formerly granted to Mr. Allen.

Machines and Mechanical Devices.

FLYING-MACHINE.—W. PHILLIPS, Chicago, Ill. In brief the invention embodies a car, a plurality of peculiarly constructed wings mounted on the car, novel means for communicating motion to and controlling the adjustment of the wings for effecting progressive movement in any direction, a guiding vane, and means for changing the position of the vane from the interior of the car.

PIANO-PLAYER.—R. MORGAN, Ellsworth, Kan. Blowing into one of the perforations the upper portion of the yoke body is rocked toward the player, thus elevating the switch and completing the circuit including the electro-magnet connected therewith, whereby to sound the key engaged by the striker corresponding to the magnet. When, however, suction is created in the perforations the yoke rocks in opposite direction and elevates the opposite plate, playing another key. It is preferable to connect the strikers to the switched plates in a way corresponding to the placing of the reeds in a mouth organ, so that one familiar with a mouth organ may operate the player.

ANIMAL-TRAP.—J. M. KELLOGG, Bozeman, Mont. The object of the present invention is to provide a trap more especially designed for catching small animals, such as mice, rats, rabbits, etc., and successively in large numbers, each caught animal resetting the trap for the next animal. It relates to traps, such as shown and described in Letters Patent of the U. S., formerly granted to Mr. Kellogg.

CREASING AND FOLDING MACHINE FOR COLLARS, CUFFS, AND THE LIKE.—H. GERHARDT, Hazelton, Pa. The invention has reference to apparatus employed in the manufacture of cuffs, collars and like wearing apparel, and the object is to provide a machine, arranged to crease a piece of fabric on all sides, to form outer sewing flaps and to fold the same over onto the fabric-body.

HANDHOLD-FORMING MACHINE.—A. J. COLVIN, C. G. HOCKETT, and J. W. FITZPATRICK, Grants Pass, Ore. In this instance the invention relates to wood working machinery, and its object is the provision of a new and improved hand hold forming machine more especially designed for cutting hand holes in boards employed for forming boxes and the like.

GEARING.—J. SCHROEDER, Davenport, Iowa. This improvement relates to gearing especially adapted for devices having a rotary beater or stirrer arranged within a receptacle and may be applied to devices of various characters, but it is especially designed to be used in connection with washing machines of the character shown and described in Letters Patent formerly issued to Mr. Schroeder.

DRILLING DEVICE.—L. K. MOORE and G. J. COSTELLO, Philadelphia, Pa. The principal object of the invention is to so construct the device that it may be used to operate the drill in obscure and inconvenient places, and to drive the drill either by hand or motive power. The invention has reference to a device for carrying and driving drills.

HYDRAULIC ELEVATOR.—R. H. BEEBE and I. R. CONCOFF, St. Johns, Ore. The object here is to provide an elevator arranged to insure full utilization of the power applied by reducing the friction of the surrounding parts to minimum, and by causing the piston in the hydraulic cylinder to exert at all times a straight-line pull on the flexible connection employed for turning the hoisting drum, and to allow the latter to travel bodily on its shaft to exert a straight-line pull on the hoisting rope.

AIR-SHIP.—W. HULL, Souris, Manitoba, Canada. The patent covers features designed to improve air ships and make them more controllable. Improvements comprise special arrangements of horizontal and vertical propellers to be employed; a series of sheets of canvas or the like are mounted on rollers so as to be wound and unwound. These to be utilized as steering sails and a certain adjustment of them gives the ship the nature of a parachute to retard downward movement. Inflatable bags are arranged to be rolled up. When unwound and inflated they serve to increase buoyancy, either for aerial navigation or to aid in sustaining the ship floating in water. Wheels may be provided for moving on land, and runners for ice.

PORTABLE COTTON COMPRESS OR BALING MACHINE.—J. W. PHILLIPS, Austin, Texas. The object of the invention is to provide a simple, powerful and economic mechanism or device, by which the material to be pressed can be subjected to great pressure, while the operation may be rapid and conducted in a manner to most satisfactorily compress the material with uniformity. Its general principle can be applied to other and various kinds of presses.

Railways and Their Accessories.

RAILROAD-SWITCH.—J. M. POWELL, Stockton, Utah. A purpose of the inventor is to improve upon the construction of the switch for which Letters Patent were formerly granted to Mr. Powell, to the extent that a short switch rail is employed between adjacent rail sections of the main line and sidings, pivotally mounted to constitute a bridge rail for the break occurring at such sections of the track, and to provide switch points having concerted movement with the switch rail.

TRACK-SANDING DEVICE.—A. A. CHURCHILL, Portland, Ore. The invention relates more particularly to specific means whereby the sand may be delivered from the sand box to the track by the force of compressed air supplied from the brake system or other source. One object is to provide means for controlling delivery of sand, that it may be manufactured by an ordinary mechanic and the use of all special castings and delicate mechanism obviated.

RAIL-FASTENING.—A. W. AVERY, Cove, N. C. The invention comprises the combination with a rail and a clamp plate, of a bolt and a tie having a slot notched in its opposite walls to receive corners of the bolt shank whereby to lock the bolt when applied to secure the clamp plate. The combination with the rail, and plate and the bolt for securing the same, of a tie plate having a slot receiving the bolt and provided with an enlarged semicircular end portion for the introduction of the bolt head, the rounded side of said portion being sloped to facilitate the introduction of the head.

Pertaining to Recreation.

ATTACHMENT FOR BAIT-HOOKS, JIGGERS, AND LIKE ANGLING DEVICES.—J. W. HAYWARD, St. Johns, Newfoundland. The object of the inventor is to provide an attachment arranged to prevent depredation of the dead bait, artificial bait or like bait by small fish, to allow convenient and safe use of choicest bait, such as mussels, cockles and other shell fish, as well as white fish, squids, herring pips and like entrails too soft to be strung on the hook; to prevent fouling of the hook on the bottom of the fishing grounds, and to securely hold bait in place for any length of time, thus requiring no hauling of lines to see if the hook is still baited or not.

Pertaining to Vehicles.

TIRE FOR VEHICLE-WHEELS.—T. F. HAMILTON, Chicago, Ill. The invention relates to improvements in vehicle wheel tires, a special object being to provide a tire formed of a plurality of similar segments so connected and secured, that in case of injury to one or more segments, said injured segments can be readily removed and replaced with new ones.

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

Notes and Queries.

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters or no attention will be paid thereto. This is for our information and not for publication.

References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.

Buyers wishing to purchase any article not advertised in our columns will be furnished with addresses of houses manufacturing or carrying the same.

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Scientific American Supplements referred to may be had at the office. Price 10 cents each.

Books referred to promptly supplied on receipt of price.

Minerals sent for examination should be distinctly marked or labeled.

(10574) T. W. A. asks: 1. A railroad train going at a rate of over 60 miles per hour rounds a sharp curve. Will the train if it should leave the track be likely to fall outward, or does the raising of the outside rail overcome this tendency and make it likely to fall inward? Grant the following: If the track were level, the train would fall outward, now if the outside rail is raised, will it fall inward? A. A railway train rounding a sharp

curve at a high speed cannot under any supposable conditions fall over in the inner side of the track. The elevation of the outer rail is made such as to overcome the tendency to overturn to the outward side of the track, and the train goes round the curve as if on a level, when it moves at the speed for which the elevation of the outer rail was calculated. If the velocity of the train very much exceeds the velocity for which the outer rail has been elevated, the train would leave the track on the outer side of the curve. The tracks for bicycle racing are made very steep at the turns in order to enable riders to go round the turns at full speed, and when rounding a turn the rider feels in equilibrium while leaning far in toward the center. To him he is as if riding on a level. The centrifugal force is neutralized by the elevation of the track or rail.

(10575) A. H. S. asks: How much more sunshine is there at the equator than at the north pole during the year? Where are the longest days—at the equator or the North Pole? We have a great argument over this question. A school teacher and others contend that the sun shone longer at the North Pole than at the equator, and I thought it absurd, so we decided to leave it to your good judgment. A. At the equator the sun rises and sets at six the entire year. All days are twelve hours long, and all nights of the same length. Disregarding the effects of refraction and cloudy weather, the sun is above the horizon at any place on the equator and shines just half of the year. This half-year of sunshine is divided into equal parts of twelve hours each. At either pole the sun is above the horizon for six months and below it for six months of the year. There is but one day of six months' duration and one night of the same length in a year. You will see from this that there is the same duration of sunshine at the poles as at the equator. The same is true for any place on the earth. Add the length of sunshine for all the days in a year in our latitude, and the sun will be just a half year. The longest day is at the pole, and it is six months long.

(10576) G. T. asks: How to remove gases of combustion and decomposition from a small room. Passing the air through a liquid would not be objectionable. A. To purify air, remove the solid particles by passing the air through cotton; the moisture and ammonia and germs, by passing through sulphuric acid; the sulphur, by passing through a solution of lead acetate. Pass now through calcium chloride or soda lime to remove last traces of moisture, etc. Only pure oxygen, nitrogen, and argon remain.

(10577) F. C. F. asks: 1. What is the best method to produce lantern slides in which the high lights will be clear glass and the shadows dense enough for the lime light? I print by contact, and have used for developing hydroquinone, metol-hydroquinone, and pyro, and an acid fixing bath, yet there always is a slight veil over the high lights. A. The only mode in which lantern slides can be produced with no development in the sky and high lights is to have a negative which is opaque in the high lights. 2. Can you give a simple method by which an amateur could color lantern slide transparencies? A. To color slides requires artistic sense and knowledge of the mixing and applying of color. We think that is all that is required. Much assistance can be had from the chapter on coloring slides in Hopkins's "Experimental Science." This book also gives instructions for making slides as well as cameras, and an exhaustless amount of scientific experimenting. 3. Why is it that water when flowing through a funnel or into a small outlet always whirls, producing a depression or an opening over the outlet? Why is the whirling always counter-clockwise? A. There is probably something in the shape of the outlet of a funnel or wash basin which determines the course of the liquid as it runs out. A loss of equilibrium is soon seen, and the water whirls. Centrifugal force is produced, caused by the opening into the pipe below. We would try to explain why the whirling is always counter-clockwise if it were so. We have just tried a wash basin, and found the motion always clockwise when left to itself. By a motion of the hand it could be made in either direction. Probably some inequality in the orifice determines the matter.

(10578) A. B. S. writes: As a long reader and subscriber of your publications, I desire to ask if there is any secret in the preparation of fluoroscopic screens for X-radiance, or if the high price is due to the high-priced material — platino-barium-cyanide (or tungstate of calcium). Where can they be procured? A. There is no secret in making a fluorescent screen for X-ray work. Skill only is required to distribute the crystals with perfect evenness and to attach them to the cardboard by the adhesive employed. The crystals must also be of uniform size, sifted through a sieve of rather a fine mesh. We should buy rather than try to make one. The cost is in the material used. It is advised that barium-platino-cyanide only will be satisfactory, since tungstate of calcium is fluorescent for quite a time after it is excited. It is cheaper but poorer, and is little used now.

(10579) J. B. S. says: I want to excavate earth and move the same to make a fill of about 60,000 cubic yards. If you know of any machinery that will do this, I would be pleased to hear from you. I do not want to go to the expense of a steam locomotive excavator. A. The only suggestions that we have to offer you for excavating earth are a steam shovel or to use hydraulic means in case there is a sufficient supply of water in the vicinity.

(10580) T. C. G. says: Can you give me reliable rules for finding the sets of elliptical and spiral car springs? Also the length a bar should be to make a spiral car spring of a given free height? Do you know where I could buy a book dealing with car springs? A. The question of calculating elliptical and spiral car springs to give definite results is an exceedingly complicated one, and one that requires considerable experience as well as theoretical knowledge. You will find quite a complete discussion of the theoretical side of this subject in the last edition of Lanza's "Applied Mechanics," with which we can supply you for $7.50 by mail.

(10581) A. E. K. says: The owners of one of the mills in this vicinity are having a great deal of trouble with foaming of the water in the boilers, and have made a trial of very nearly everything that has been suggested to remedy this. A sample of the water was sent to the University of Minnesota for analysis, and I inclose copy of a letter received in reply. If you can suggest anything that would be of service the favor will be greatly appreciated. A. We doubt if it will be possible for you to avoid trouble from foaming with water containing as much organic matter as the analysis which you inclose shows. If it is possible, we would advise another source of supply, even though the expense of procuring it is considerable. If this is impossible, the only practical suggestions which we have to offer are: 1. Blow off your boiler very frequently and very generously, so as to prevent the impurities becoming concentrated. 2. Do not force your boiler, but if necessary, increase your boiler capacity so as to be able to generate the steam that you require at a low rate of evaporation. 3. In case you have a sufficient supply of water, we would strongly advise you to introduce surface condensers, only adding enough impure water to your boilers to make good the leakages. 4. In case there is not sufficient water supply to enable you to use surface condensers in the ordinary method, we would advise your building a shallow evaporation tank to cool the condensing water, so that you may use the same condensing water over and over again in your condensers. This will require only enough water to make good the evaporation. Either of the suggestions contained in No. 3 or No. 4 will give a satisfactory solution of your problem, but we doubt if anything else will.

(10582) M. F. F. asks: 1. State what effect oil or greases in a boiler may have upon the boiler itself. A. In answer to your first inquiry, we would say that greases in a boiler are almost always injurious, as they cause foaming and are apt to decompose, forming acids which affect the plates of the boiler injuriously. A small amount of pure mineral oil like kerosene will sometimes tend to loosen a scale which is troublesome and prove beneficial, but grease should not be used for this purpose. 2. Where low-pressure engines are used, state what vacuum is maintained? A. We infer that your questions regarding low-pressure engines refer to marine practice. The vacuum maintained here varies with the design of the engines and the condensers from 24 to 25 inches of mercury to 27 or 28 inches. 3. What is meant by this amount of vacuum? A. The amount of vacuum is usually expressed in inches of mercury. If the vacuum were perfect, it would be equal to the full atmospheric pressure, which varies with the weather, but on an average is equal to 29.9 inches of mercury, or 14.7 pounds per square inch. A condensing engine can never have a perfect vacuum because it cannot cool the exhaust steam far enough. The lower the temperature to which it does bring the exhaust steam, the more perfect will be the vacuum.

(10583) T. N. K. says: Will you kindly give me horse-power of a fore-and-aft compound engine 8 and 17 x 12, 200 pounds boiler pressure, 300 revolutions per minute, 25 inches vacuum? A. You do not give sufficient information in your letter to make it possible for us to exactly calcuate the horse-power of 8 and 17 x 12 tandem compound engine which you mention. The power varies with the point of cut-off in the two cylinders, the amount of compression and the throttling of the steam during the admission and exhaust. If the engine is well designed, however, the power does not probably vary very much from 250 horse-power when running at 300 revolutions per minute with a boiler pressure of 200 pounds and 25 inches vacuum. We would require indicator cards from both cylinders to give information necessary to figure exact horse-power.

(10584) F. A. T. asks: Is there any gain in power by using an Archimedes screw beyond the power required to work an ordinary pump? A. There is no gain in power by using an Archimedes screw over the power required for an ordinary pump. Its efficiency is so low that it is not used in practice, and we therefore cannot tell you where you can see one. The principle of its action is just the same as that of the screw conveyors used for feeding coal into furnaces, to convey grain, etc.

NEW BOOKS, ETC.

LE CARBONE ET SON INDUSTRIE. By Jean Escard. Paris: H. Dunod et E. Pinat, 1906. Paper; 751 pages; 129 illustrations. Price, $7.50.

M. Jean Escard in his new work has taken for his end as complete and wide a description as possible of the recent applications of the different forms of carbon, putting stress on those which have a particular interest or an especial industrial application. After a general dissertation on the properties of carbon so as to familiarize the reader with the modifications which will be presented to him later, and also to avoid repetitions in the following chapters, the author commences with a study of the diamond and its applications. Graphite, which is worthy of next being discussed, is dealt with at length. The author does not fear to lay great weight on the physical and chemical characteristics of a number of the many varieties of this substance, and to describe with care the principal localities in which this mineral is found. In the next chapter, the reader can gain some idea of the interest that is shown in investigating the properties of amorphous carbon, each variety having special applications of its own. The last two chapters, given over to bituminous coal, are particularly alluring. The author gives not only a view of this mineral and of its properties, but a description of the localities in which it is found in France as well as in Europe and in the other parts of the world, and he has endeavored to interest the reader by adding some new considerations on the exhaustion of coal mines, and on the fuels of the future. M. Escard in many places evolves his own hypotheses on the formation of certain forms of carbon parallel to those which other authors have already set forth. The many researches that he has carried on in the mines, as well as his particular studies of locations, will give to the reader confidence in his assertions. It is certain that this work, the first that has appeared on the question of the industrial uses of carbon, will receive a great welcome in the industrial world.

LES FORCES HYDRAULIQUES ET LES APPLICATIONS ELECTRIQUES AU PÉROU. Par Em. Guarini, Professeur à l'Ecole d'Arts et Métiers de Lima. Paris: H. Dunod et E. Pinat. 8vo., 24 pages, 12 illustrations. Price, $3.

M. Em. Guarini, in this pamphlet, tells of his journey in the south of Peru, to Mollendo, Tambo, Arequipa, and Lake Titicaca. He gives special consideration to the hydraulic possibilities of this region, and to their utilization as sources of electricity. Numerous drawings, and examples of application with calculations allow one to gain an idea of the great resources of Peru, and of the means of utilizing them economically. The possibility of making use of Lake Titicaca is the most important part of this interesting work.

TECHNISCHE ANWENDUNGEN DER PHYSIKALISCHEN CHEMIE. By Dr. Kurt Arndt. Berlin: Mayer & Müller, 1907. 12mo. pp. 304.

The author has written this book primarily to meet the requirements of engineers, proprietors of industrial works, teachers, and students. The explanations are clear and do not demand much preliminary knowledge. The author has relied more upon a system of concrete reasoning than upon theoretical abstract discussions to drive his truths home. The chapters include excellent summaries of the Fixation of Atmospheric Nitrogen; Gas Making; Contact Process of the Manufacture of Sulphuric Acid; Production of Ammonia and Ozone; Reaction Accelerators; Vaporization and Condensation; Solutions of Alloys; Colloid Solutions; Dissociation Pressures; and Measurements of High Temperatures.

DIE BETRIEBSSICHERHEIT DER EISENBAHNEN. Sonderabdruck aus dem "Archiv fuer Eisenbahnwesen." Von C. Guillery, königlicher Baurat. Verlag von Julius Springer in Berlin N. pp. 645-659.

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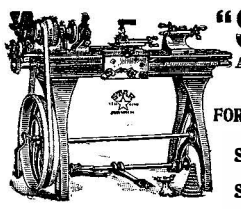

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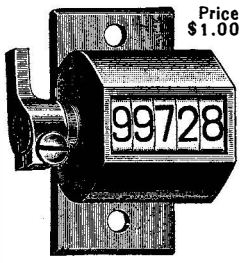

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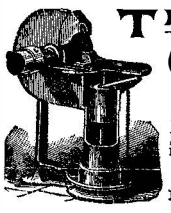

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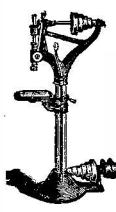

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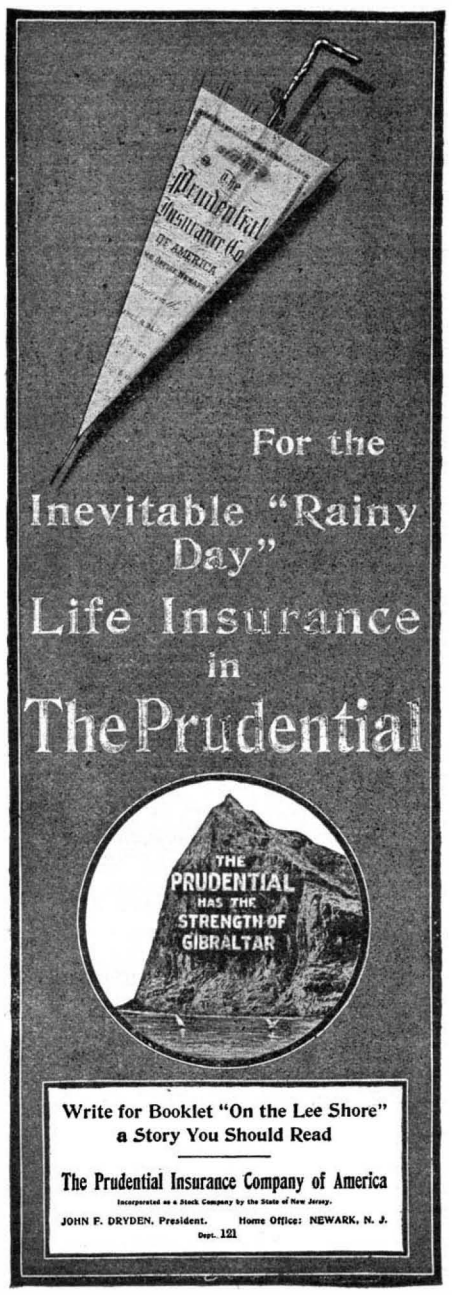

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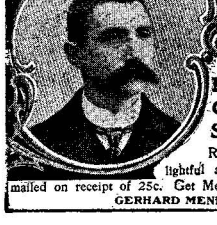

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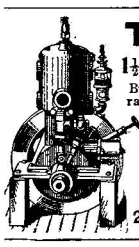

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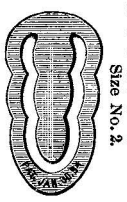

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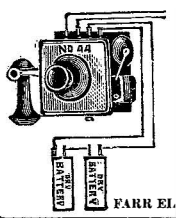

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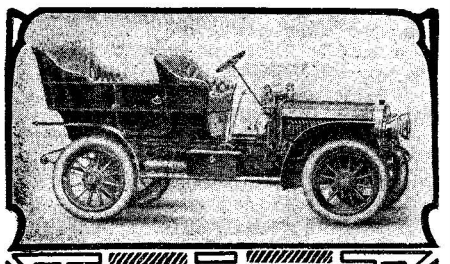

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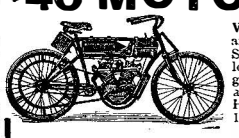

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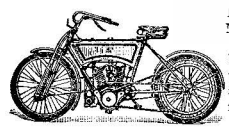

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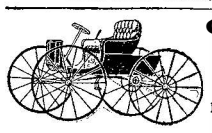

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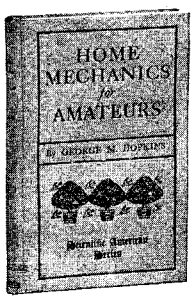

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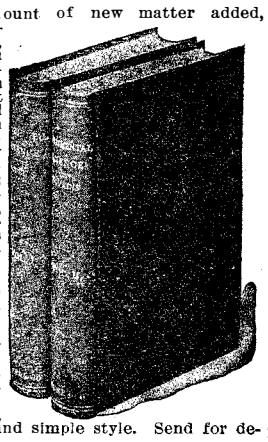

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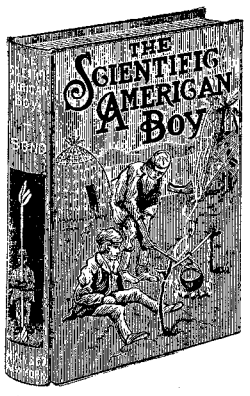

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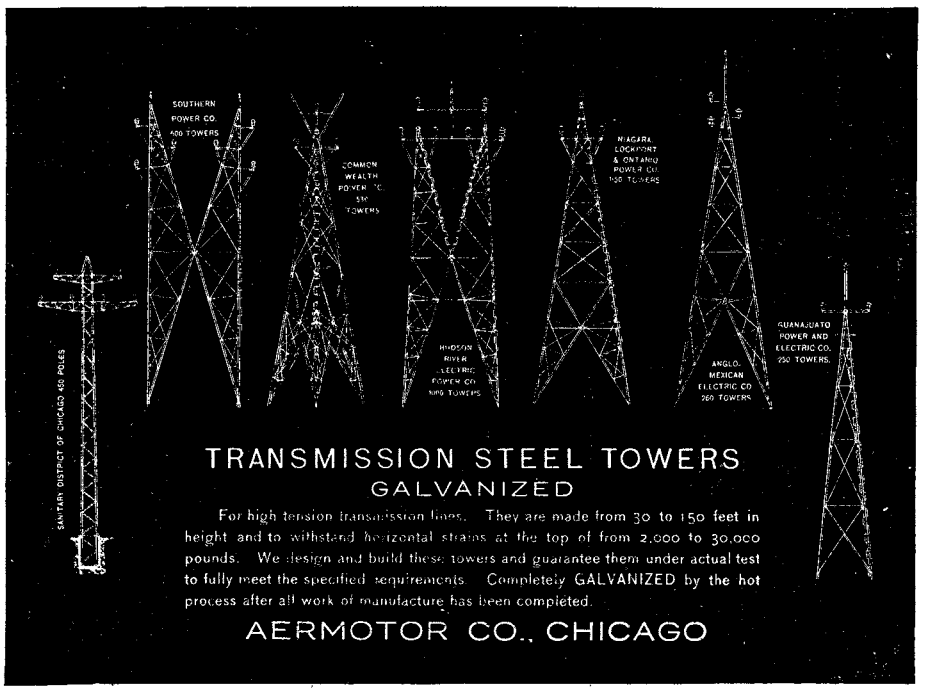
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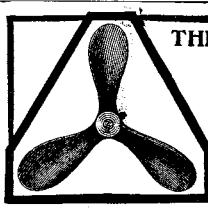

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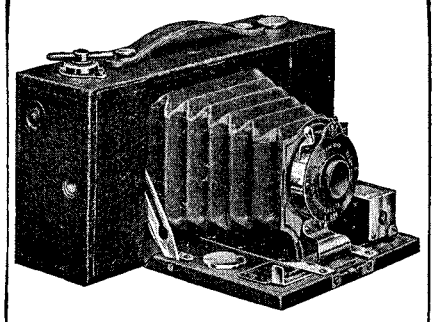

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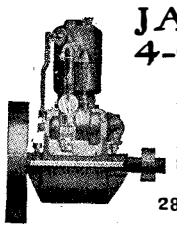

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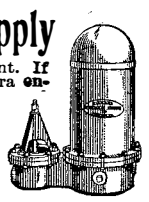

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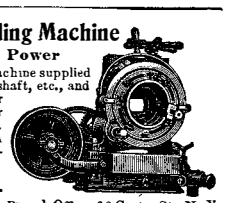

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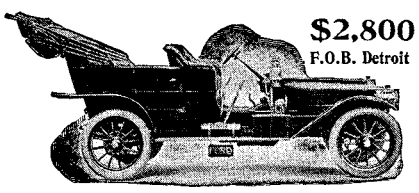

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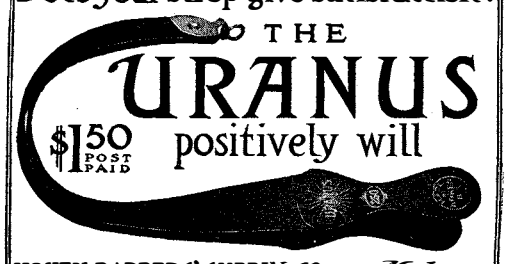

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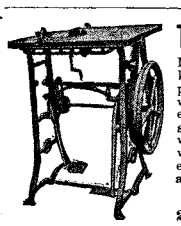

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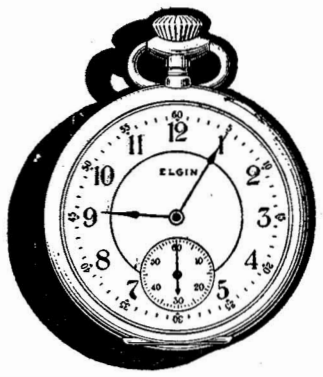

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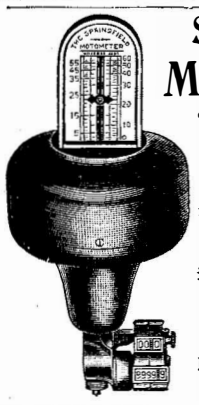

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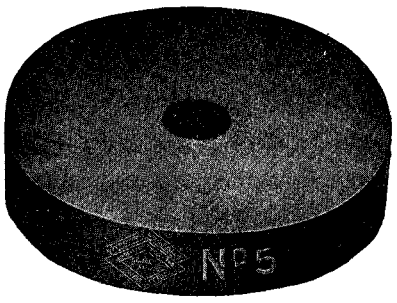

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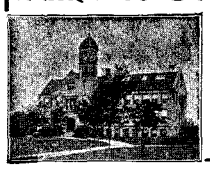

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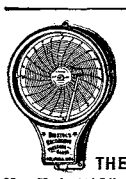

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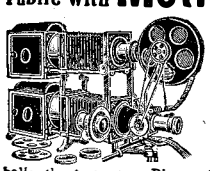

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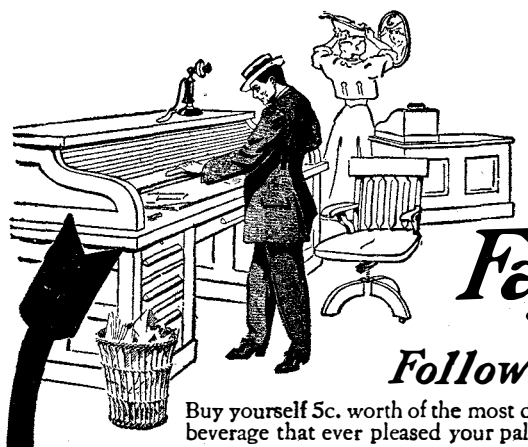

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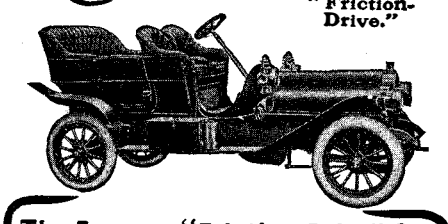

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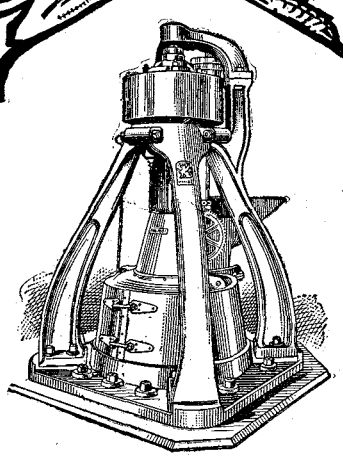

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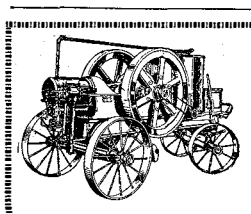

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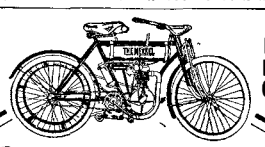

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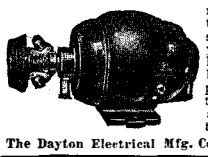

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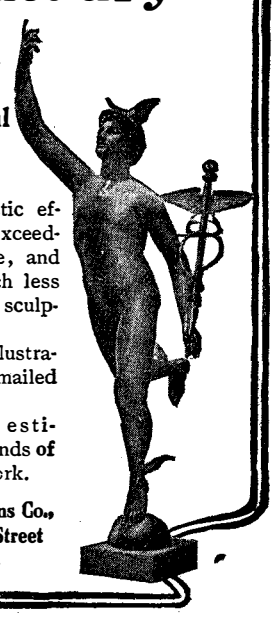

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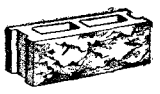

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